

Science

Prep

3



Mrs. Mona Younes

01091456501

Chemical Reaction

Part 1

Chemistry Revision

Valency

It is the number of electrons that an atom gains, loses or even shares during a chemical reaction.

Metals		Nonmetals	
Element		Element	
Lithium (Li)	1 Monovalent	Hydrogen (H)	1 Monovalent
Potassium (K)		Chlorine (Cl)	
Sodium (Na)		Fluorine (F)	
Silver (Ag)		Bromine (Br)	
Copper I (Cu)		Iodine (I)	
Calcium (Ca)	2 Divalent	Sulphur (S)	2 Divalent
Magnesium (Mg)		Oxygen (O)	
Iron II (Fe)		Nitrogen (N)	3 Trivalent
Lead (Pb)		Phosphorus (P)	
Copper II (Cu)		Sulphur (S)	4 Tetravalent
Mercury (Hg)		Carbon (C)	
Zinc (Zn)		Nitrogen (N)	5 Pentavalent
Aluminum (Al)	3 Trivalent	Phosphorus (P)	
Gold (Au)		Sulphur (S)	6 Hexavalent
Iron III (Fe)			

★ Some elements have more than one valency such as:

Copper (Cu):

→ Copper I: monovalent (1).

→ Copper II: divalent (2).

Sulphur (S)

→ Divalent (2).

→ Tetravalent (4).

→ Hexavalent (6).

Iron (Fe)

→ Iron II (Ferrous Fe^{+2}): divalent (2).

→ Iron III (Ferric Fe^{+3}): trivalent (3).

**Nitrogen (N)
Phosphorus (P)**

→ Trivalent (3).

→ Pentavalent (5).

The atomic group (Radical)

It is a set of atoms of different elements joined together and behave like one atom during a chemical reaction, having its own valency and it is not existed solely.

Atomic group	Symbol	Valency
Hydroxide	$(OH)^{-}$	1 Monovalent
Bicarbonate	$(HCO_3)^{-}$	
Nitrate	$(NO_3)^{-}$	
Nitrite	$(NO_2)^{-}$	
Ammonium	$(NH_4)^{+}$	

Atomic group	Symbol	Valency
Carbonate	$(CO_3)^{-2}$	2 Divalent
Sulphate	$(SO_4)^{-2}$	

Atomic group	Symbol	Valency
Phosphate	$(PO_4)^{-3}$	3 Trivalent

Chemical formula

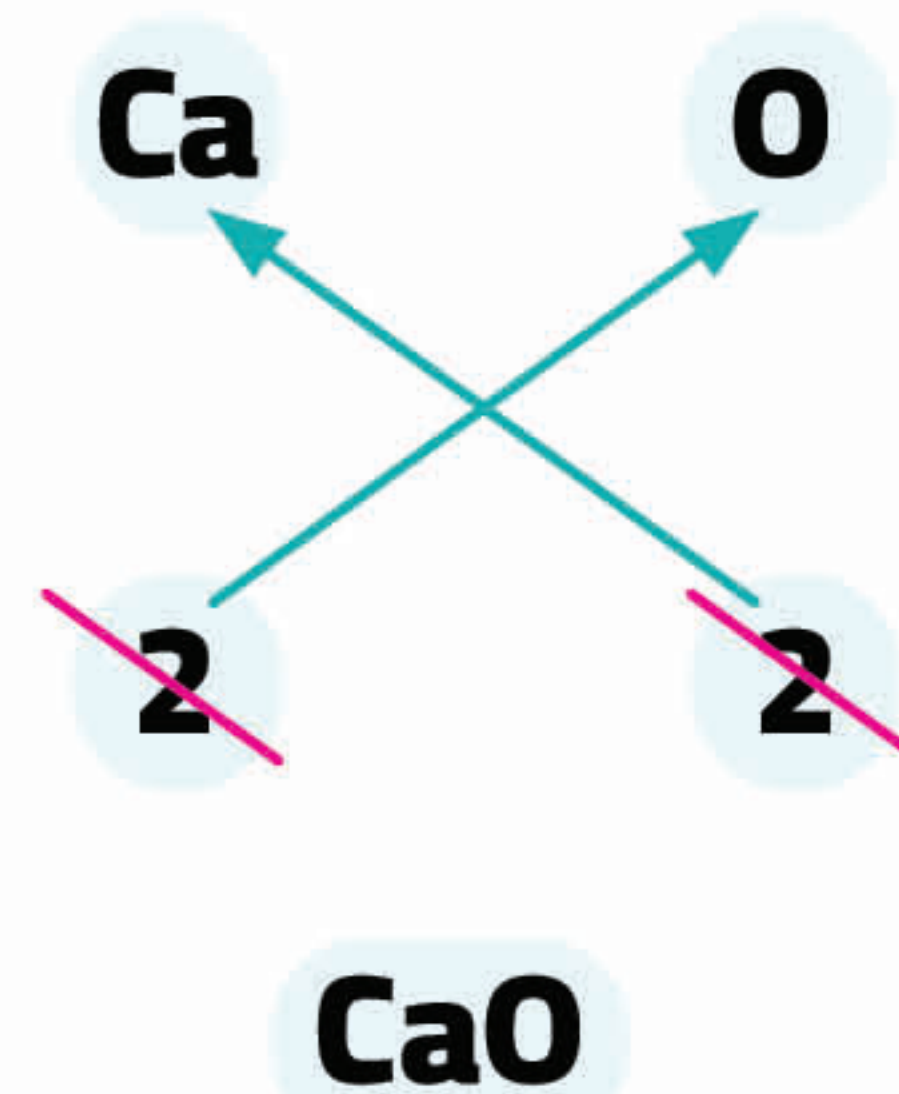
Chemical formula

It is a formula that represents the number and the type of the atoms in a molecule.

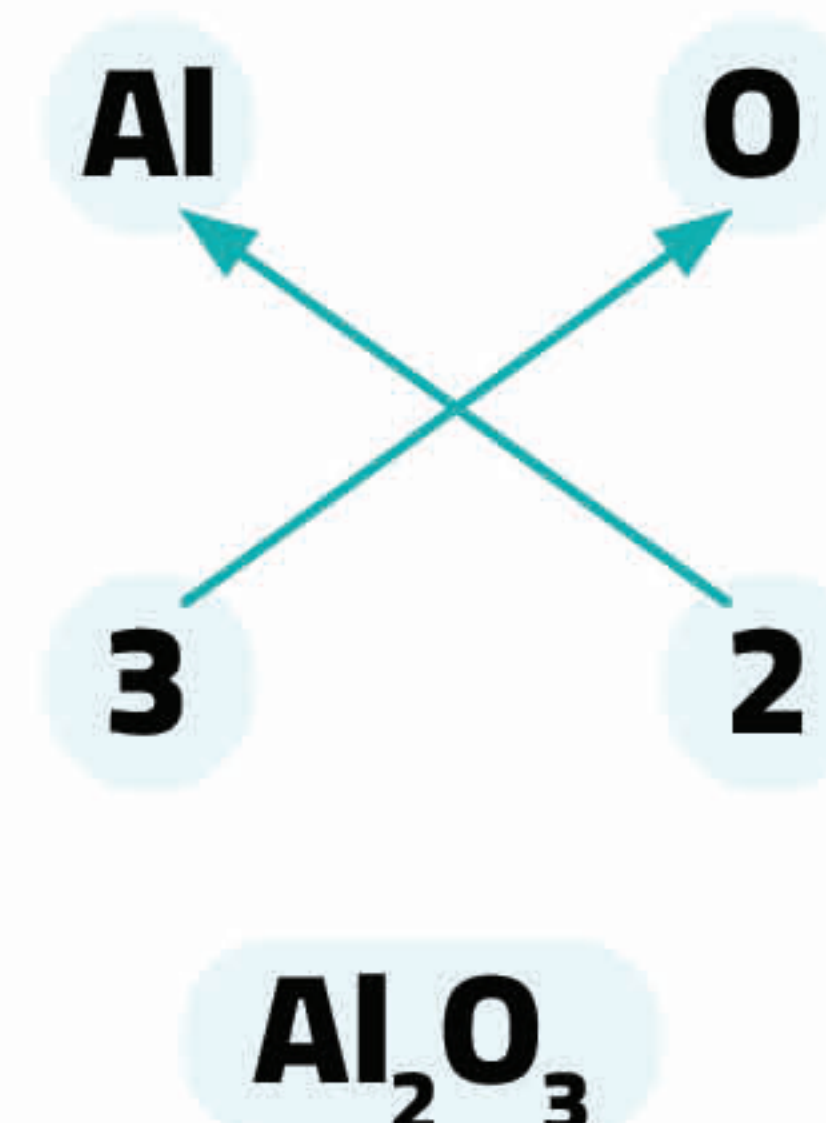
How can you write a chemical formula for a compound?

- 1 Write the name of the compound in words.
- 2 Write the symbol of each element or atomic group down to the name.
- 3 Write the valence down to each symbol or atomic group.
- 4 Exchange their valencies and simplify them.

Calcium oxide



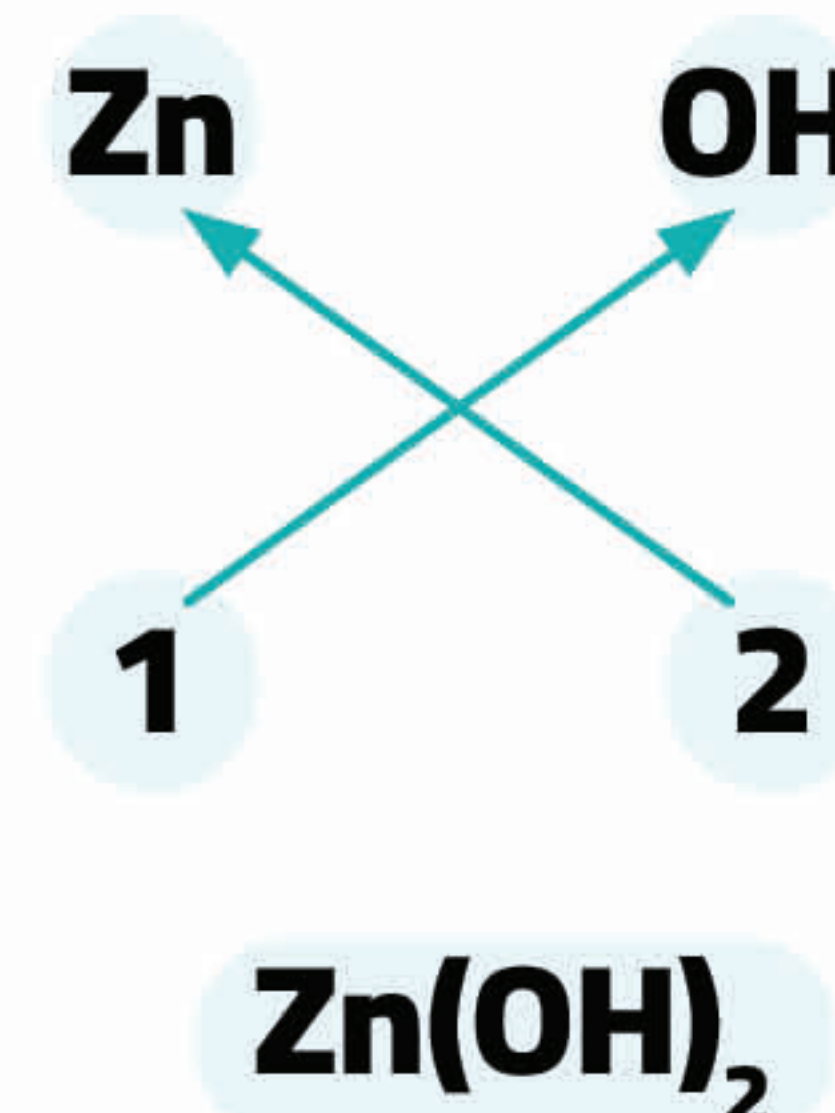
Aluminum oxide



Notes

- 1 You don't have to write the one (1).
- 2 In case of atomic groups, if the number is not (1), put the atomic group between brackets and write the number right down to it.

Zinc hydroxide



The fomula of a compound

Starts from left with a metal or hydrogen or a positive atomic group.

Ends on right with a symbol of nonmetal or a negative atomic group.

Chemical reaction

It is the breaking up of bonds in the reactants molecules and formation of new bonds in the products (resultants) molecules from the reaction.

Importance of chemical reactions

1. Burning of car fuel (gasoline) in the car engine generates power, which causes cars to move.
2. Plants make their food through photosynthesis process, which depends mainly on the reaction of carbon dioxide with water.
3. Medicines, fertilizers and artificial fibers are examples of products of some chemical reactions.

1. Decomposition of some metal oxides.
2. Decomposition of some metal hydroxides.
3. Decomposition of most metal carbonates.
4. Decomposition of most metal sulphates.
5. Decomposition of some metal nitrates.

Thermal decomposition reactions

Types of chemical reactions

Oxidation and reduction reactions

1. According to traditional concept.
2. According to electronic (modern) concept.

Substitution reactions

Simple

1. A metal substitutes hydrogen of water.
2. A metal substitutes hydrogen of diluted acid.
3. A metal substitutes another one in its salt solution.

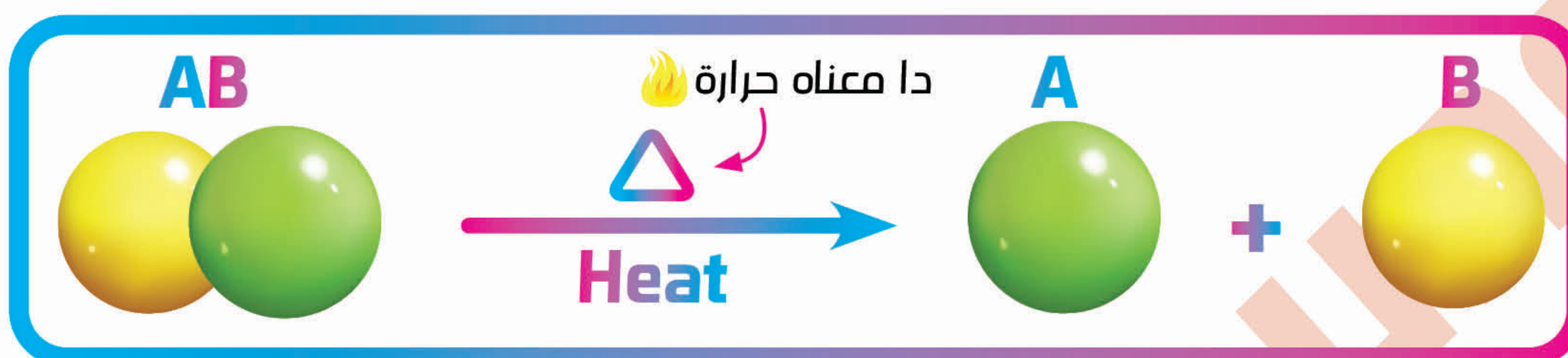
Double

1. An acid with an alkali.
2. An acid with salt.
3. Two salt solutions.

First: Thermal Decomposition Reactions

Thermal decomposition reactions

They are chemical reactions which involve the breaking up of the components with the effect of heat into its primary elements or simpler compounds than the original ones.



1 Thermal decomposition of some metal oxides

★ Some metal oxides decompose by heat into metal and oxygen gas evolves.



★ Example: Red mercuric oxide decomposes by heat into mercury (silvery precipitate) at the bottom of the tube, and oxygen gas evolves (which increases the glow of a burning match).



2 Thermal decomposition of some metal hydroxides

★ Some metal hydroxides decompose by heat into metal oxide and water vapor evolves.



★ Example: copper hydroxide (blue color) decomposes by heat into copper oxide (black color) and water vapor evolves.



3 Thermal decomposition of most metal carbonates

- Most metal carbonates decompose by heat into metal oxide and carbon dioxide gas evolves.



- Example: Green copper carbonate decomposes by heat into copper oxide (black color) and carbon dioxide gas evolves (which turbids clear limewater).



4 Thermal decomposition of most metal sulphates

- Most metal sulphates decompose by heat into metal oxide and sulphur trioxide gas evolves.



- Example: Blue copper sulphate decomposes by heat into copper oxide (black color) and sulphur trioxide gas evolves.

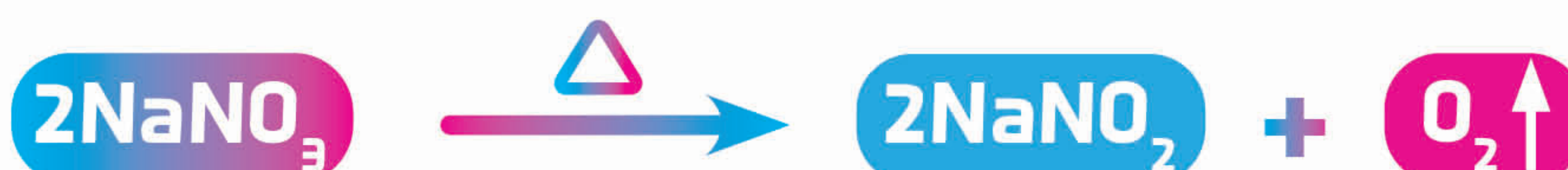


5 Thermal decomposition of some metal nitrates

- Most metal nitrates decompose by heat into metal nitrite and oxygen gas evolves.



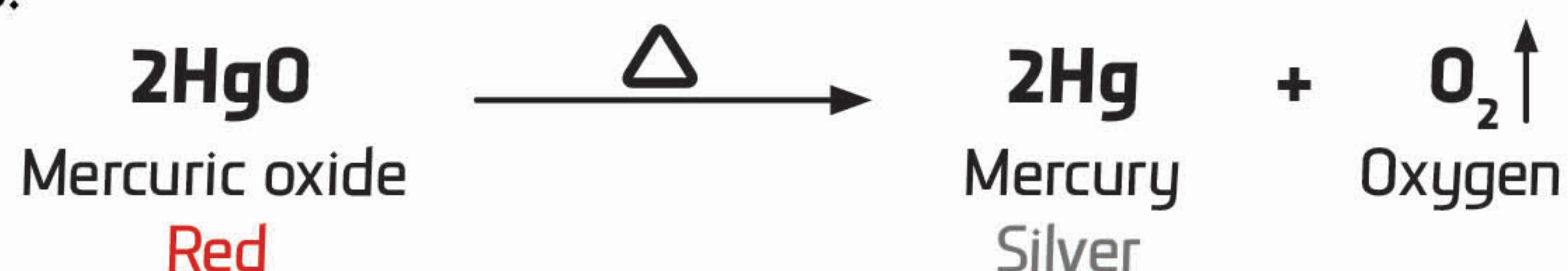
- Example: White sodium nitrate decomposes by heat into sodium nitrite (yellowish white color) and oxygen gas evolves (which increases the glow of a burning match).



GIVE REASON

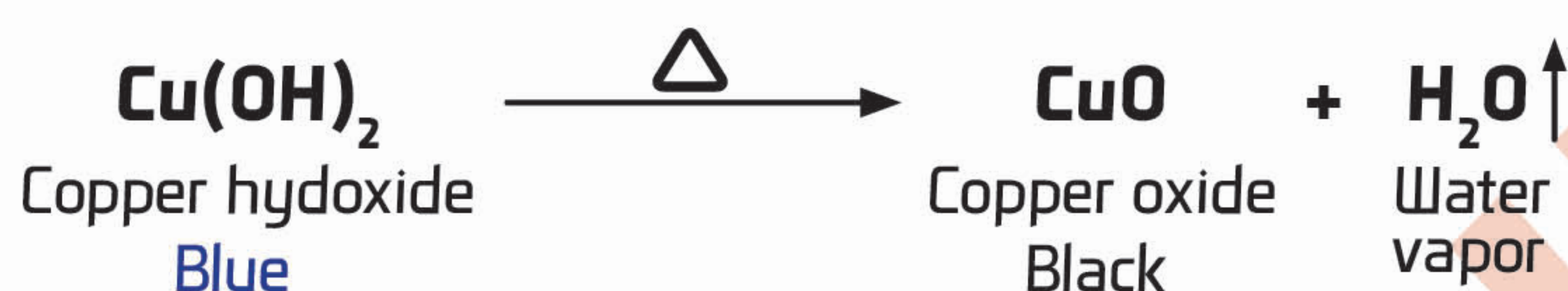
1 The formation of silvery color by heating and mercuric oxide.

Due to the decomposition of red mercuric oxide by heat into mercury (silver precipitate) and oxygen gas evolves.



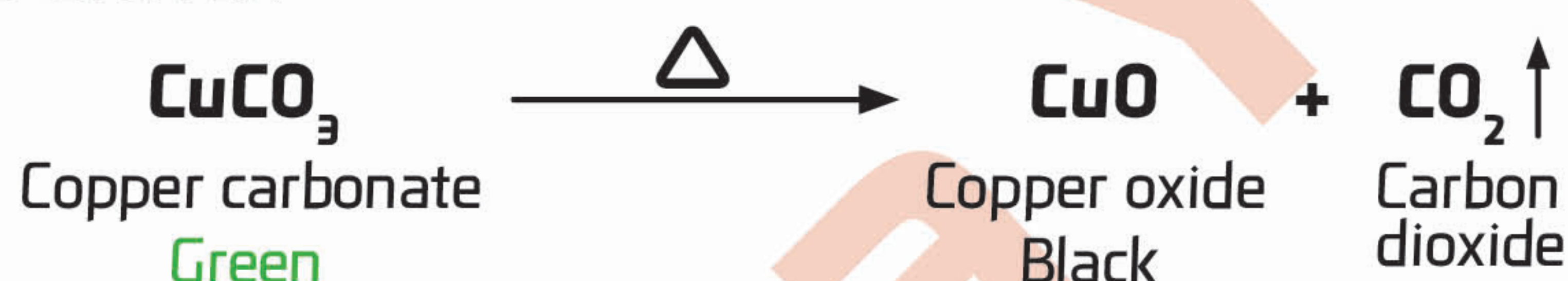
2 The formation of black substance by heating blue copper hydroxide.

Due to the decomposition of blue copper hydroxide by heat into copper oxide (black) and water.



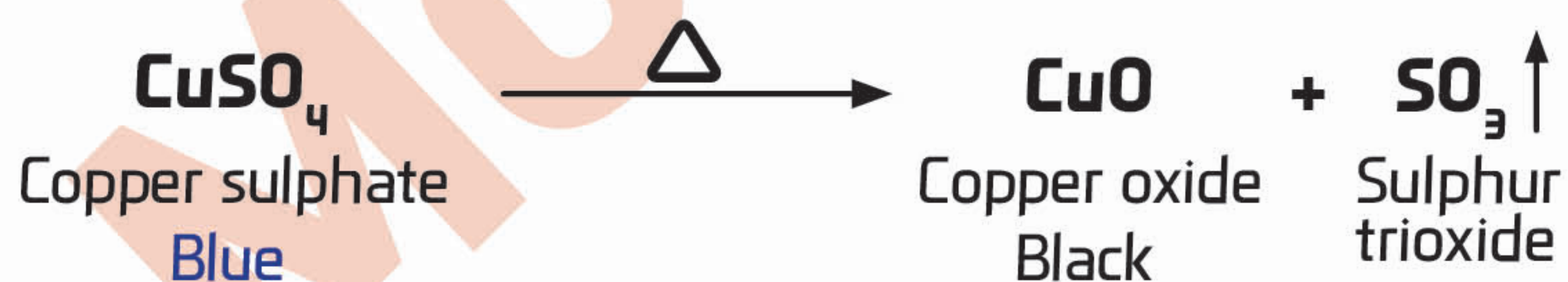
3 The formation of black substance by heating green copper carbonate.

Due to the decomposition of green copper carbonate by heat into copper oxide (black) and carbon dioxide gas evolves.



4 The blue color of copper sulphate turns into black by heating.

Due to the decomposition of blue copper sulphate by heat into copper oxide (black) and sulphur trioxide gas evolves.



5 A yellowish white color is formed on heating white sodium nitrate.

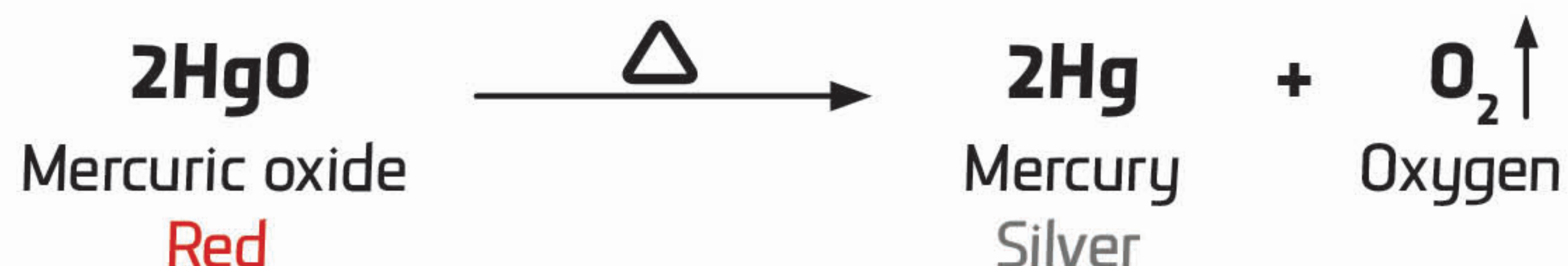
Due to decomposition of white sodium nitrate by heat into sodium nitrite (yellowish white) and oxygen gas evolves.



WHAT HAPPENS WHEN

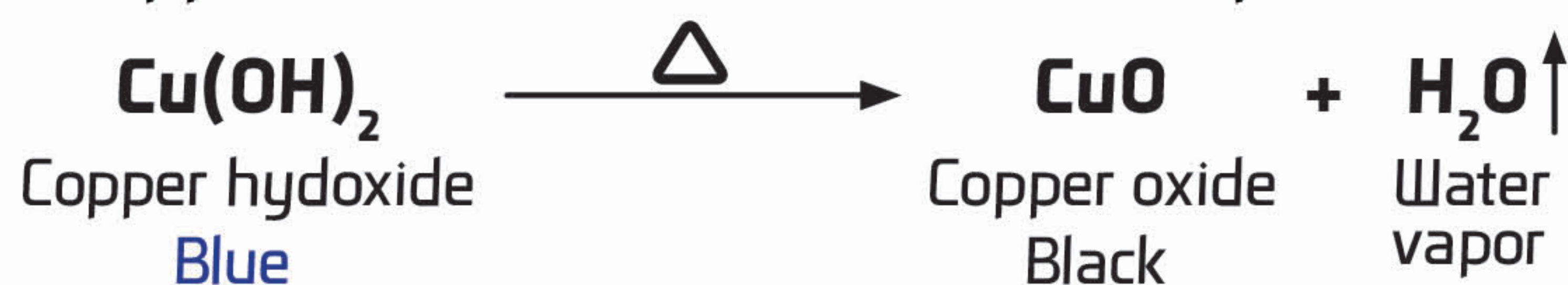
1 Heating of red mercuric oxide.

A silvery precipitate of mercury is formed and oxygen gas evolves.

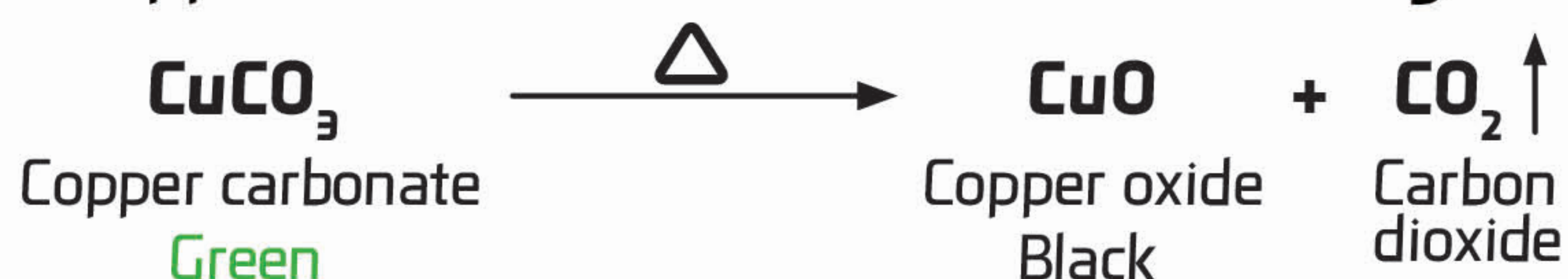


2 Heating of copper hydroxide.

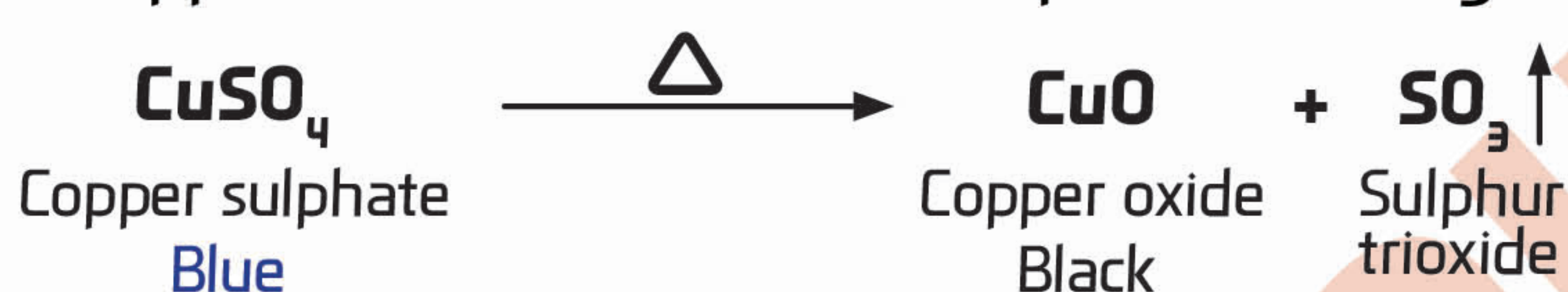
A black substance of copper oxide is formed and water vapor evolves.

**3 Heating of copper carbonate.**

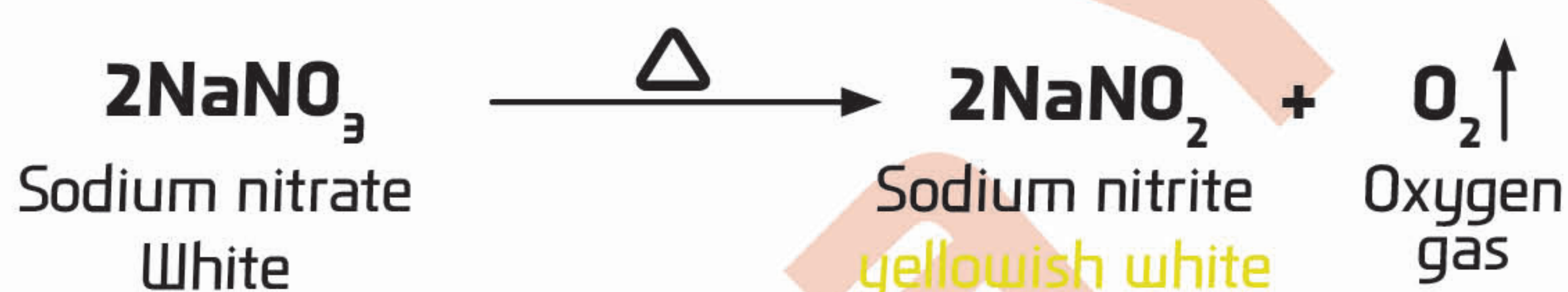
A black substance of copper oxide is formed and carbon dioxide gas evolves.

**4 Heating of blue copper sulphate.**

A black substance of copper oxide is formed and sulphur trioxide gas evolves.

**5 Heating of sodium nitrate.**

A yellowish white substance of sodium nitrite is formed and oxygen gas evolves.

**APPLICATIONS****Air bags****Definition**

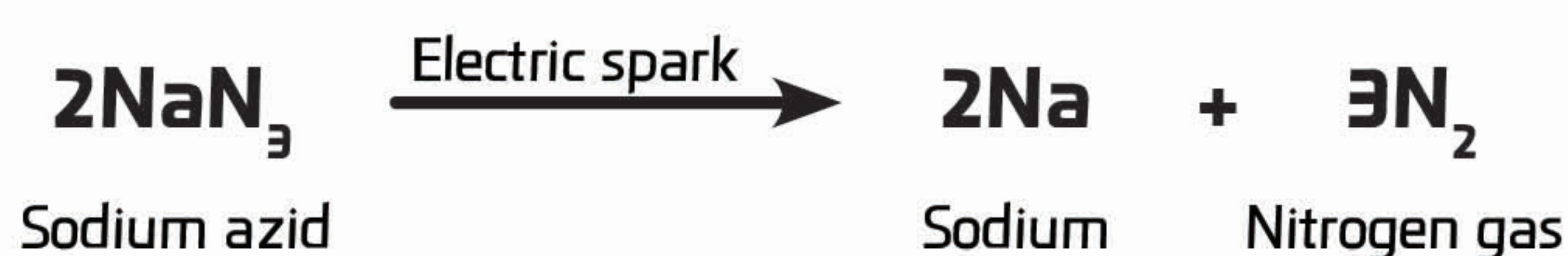
It is an inflatable bag folded inside the steering wheel in modern cars.

Importance

They are considered one of the most safety means in cars at emergencies.

Idea of operation

- 1 When a car crashes or drops its speed suddenly, an electric spark is generated.
- 2 This spark works on decomposition and explosion of the substance of sodium azid (present in the air bag) forming sodium and nitrogen gas evolves.
- 3 The bag gets inflated by the nitrogen gas at an extreme speed (within only 40 milli second).



- 4 Then the bag gets vacuumed rapidly to ensure clear vision and proper movement for the driver.

Reactant	Products	Examples
Metal oxide	Metal + Oxygen gas	$2\text{HgO} \xrightarrow{\Delta} 2\text{Hg} + \text{O}_2 \uparrow$ Mercuric oxide (Red) → Mercury (Silver) + Oxygen
Metal hydroxide	Metal oxide + Water vapor	$\text{Cu}(\text{OH})_2 \xrightarrow{\Delta} \text{CuO} + \text{H}_2\text{O} \uparrow$ Copper hydroxide (Blue) → Copper oxide (Black) + Water vapor
Metal Carbonate	Metal oxide + Carbon dioxide gas	$\text{CuCO}_3 \xrightarrow{\Delta} \text{CuO} + \text{CO}_2 \uparrow$ Copper carbonate (Green) → Copper oxide (Black) + Carbon dioxide
Metal Sulphate	Metal oxide + Sulphur trioxide gas	$\text{CuSO}_4 \xrightarrow{\Delta} \text{CuO} + \text{SO}_3 \uparrow$ Copper sulphate (Blue) → Copper oxide (Black) + Sulphur trioxide
Metal nitrate	Metal nitrite + Oxygen gas	$2\text{NaNO}_3 \xrightarrow{\Delta} 2\text{NaNO}_2 + \text{O}_2 \uparrow$ Sodium nitrate (White) → Sodium nitrite (yellowish white) + Oxygen gas

Second: Substitution Reactions

★ Substitution reactions occur when an active element replaces (substitutes) another less active element in another compound.

Chemical Activity Series

It is the arrangement of metals in a descending order according to the degree of their chemical activity.

Please **S**end **B**ats, **C**ats, **M**onkeys **A**nd **Z**ebra **I**n **T**heir **L**ovely **H**appy **C**ages **M**ade of **S**ilver, **P**latinum, and **G**old.

1 Simple substitution reactions

Simple substitution process

They are chemical reactions in which one of the elements substitutes another less active element in a solution of one of its compounds.

Element	Symbol
Potassium	K
Sodium	Na
Barium	Ba
Calcium	Ca
Magnesium	Mg
Aluminum	Al
Zinc	Z
Iron	Fe
Tin	Sn
Lead	Pb
Hydrogen	H
Copper	Cu
Mercury	Hg
Silver	Ag
Platinum	Pt
Gold	Au



A A metal substitutes hydrogen of water

★ Metals which precede hydrogen in C.A.S. Substitute hydrogen of water forming metal hydroxide and hydrogen gas evolves.



★ Sodium substitutes the hydrogen of water giving sodium hydroxide and hydrogen gas evolves which burns with a pop sound and the reaction is accompanied by releasing of heat.



B A metal substitutes the hydrogen of diluted acid

★ Metals which precede hydrogen in C.A.S. Substitute hydrogen of diluted acid forming salt of an acid and hydrogen gas evolves.



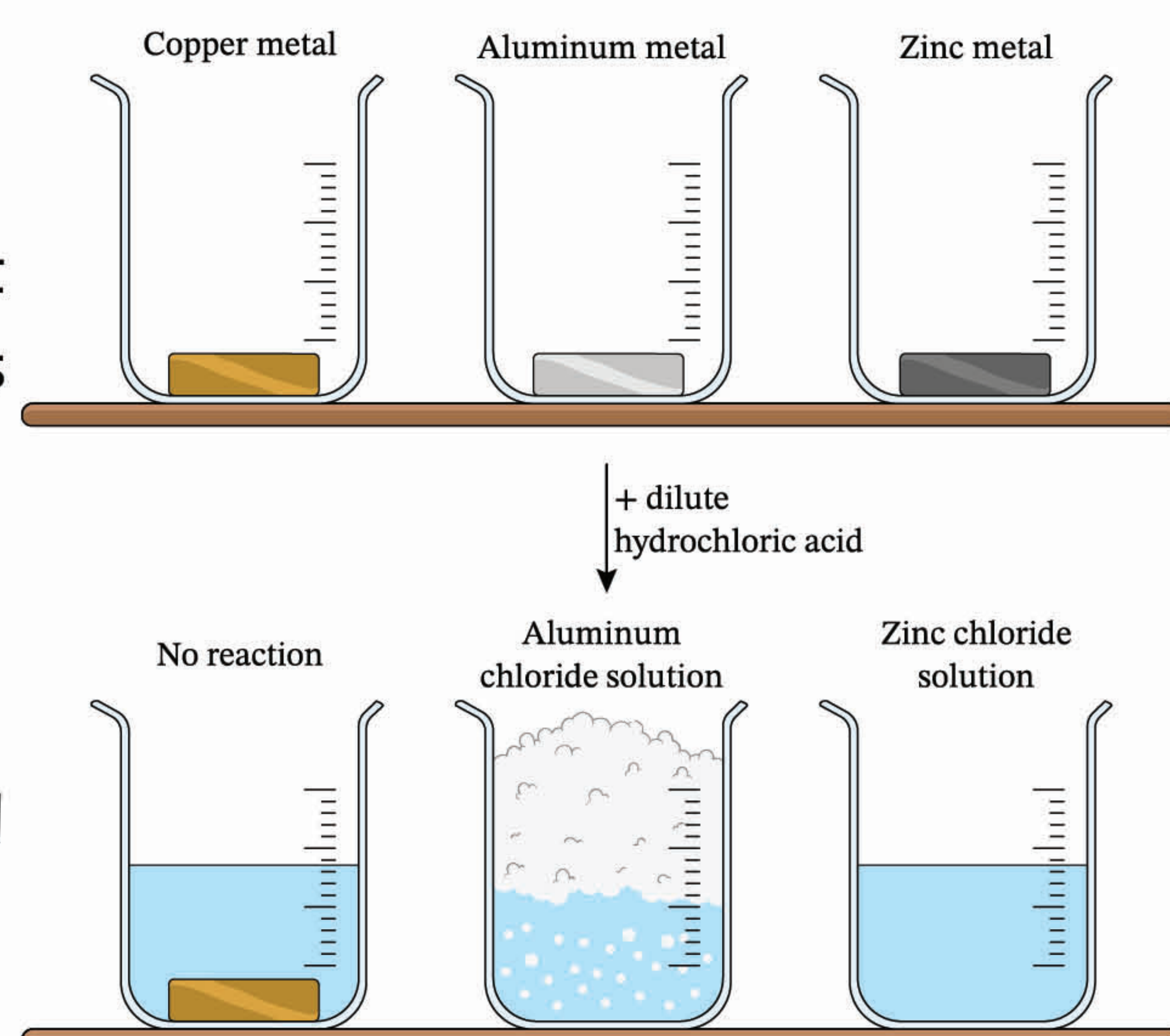
★ Zinc replaces the hydrogen of diluted hydrochloric acid forming zinc chloride and hydrogen gas evolves **immediately**.



★ Aluminum replaces the hydrogen of diluted hydrochloric acid forming aluminum chloride and hydrogen gas evolves (effervescence) **after a short time**.

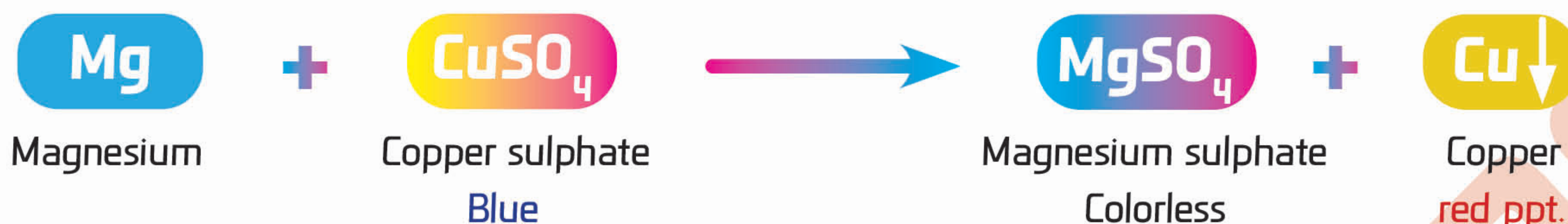


★ Copper doesn't replace the hydrogen of diluted hydrochloric acid and no gas bubbles evolve.



C A metal substitutes another one in its salt solution

★ Some metals replace another metals (in their salt solutions) that follow them in C.A.S.



NOTES

- 1 As the distance between metals increases in C.A.S., the substitution becomes faster.
- 2 Potassium (K) reacts instantly with water, while magnesium (Mg) reacts very slowly with cold water.



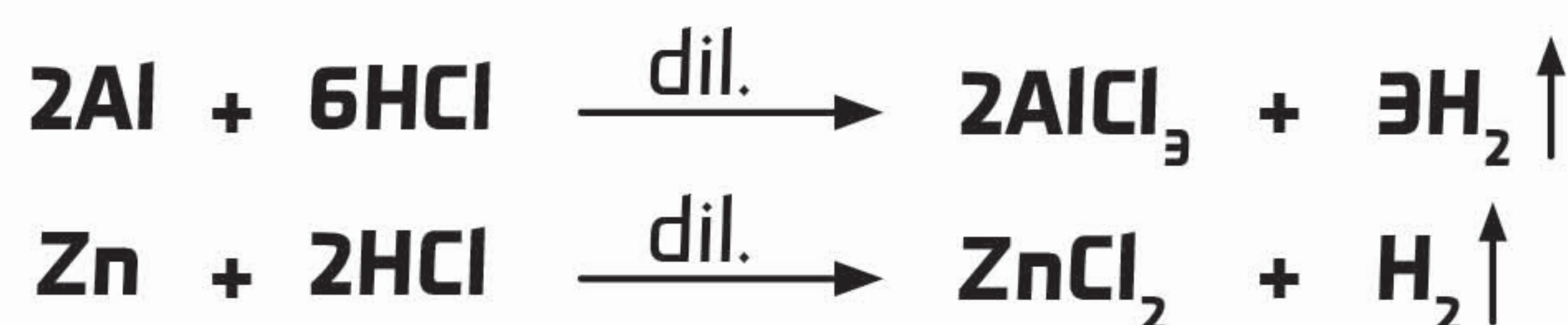
GIVE REASON

1 The arrangement of metallic elements in the chemical activity series.

To compare between elements concerning the degree of chemical activity, where the most active element replaces the less active one.

2 Zinc and aluminum replace the hydrogen of diluted acid forming salt of an acid and hydrogen gas evolves.

Because zinc and aluminum precede hydrogen in C.A.S.



3 The occurrence of effervescence on putting a piece of aluminum in diluted hydrochloric acid.

Because aluminum precedes hydrogen in C.A.S.



4 Copper doesn't replace the hydrogen of diluted acid.

Because copper comes after hydrogen in C.A.S.

5 Although aluminum comes before zinc in C.A.S., aluminum delays after zinc in the reaction of diluted hydrochloric acid.

Due to the presence of a layer of aluminum oxide (Al_2O_3) on aluminum surface, which takes time to separate from aluminum, that delays the starting of occurrence of the reaction.

6 Sodium reacts with dil. HCl, while copper doesn't react with the same acid.

Because sodium can replace the hydrogen of diluted acid as it comes before hydrogen in the chemical activity series, while copper comes after the hydrogen.

**7 Magnesium can replace another copper in its solutions, while the opposite doesn't occur.**

Because magnesium precedes copper in C.A.S., so it replaces copper, but copper follows magnesium, so it cannot replace magnesium.

**8 A red precipitate is formed when magnesium is added to copper sulphate solution.**

Because magnesium precedes copper in C.A.S., so it replaces copper in copper sulphate solution and red copper precipitate is formed.

**9 • Don't keep silver nitrate solution in aluminum containers.**

• Tarek objected when he found one of his colleagues keeping silver nitrate solution in an aluminum container.

Because aluminum precedes silver in C.A.S., so it replaces silver in silver nitrate solution which leads to eroding of aluminum containers.

WHAT HAPPENS WHEN**1 Adding a piece of sodium to water.**

An ignition occurs accompanied by a strong pop sound.

**2 Adding diluted HCl to a piece of copper.**

No reaction occurs.

3 Adding diluted HCl to zinc turnings.

Zinc reacts with dil. HCl immediately and hydrogen gas evolves.



4 Adding magnesium ribbon to blue copper sulphate solution.

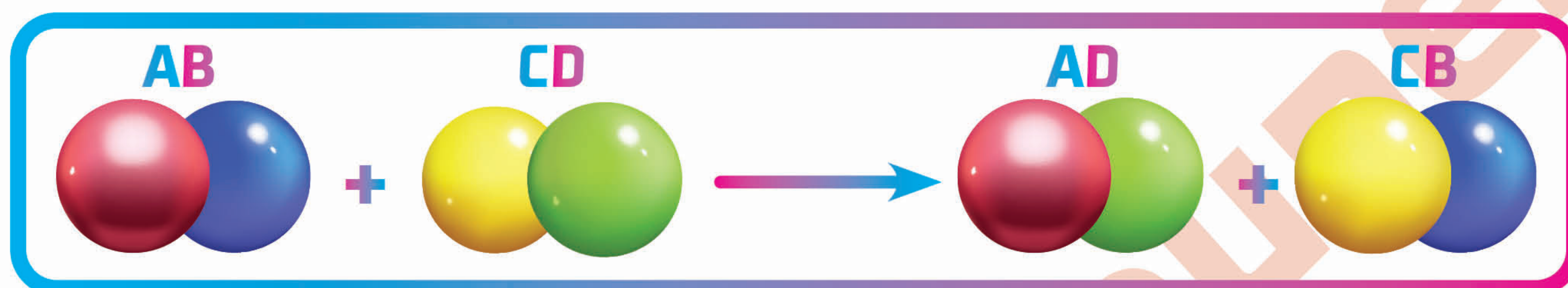
The blue color of copper sulphate disappears and a red precipitate of copper is formed.



2 Double substitution reactions

Double substitution process

They are chemical reactions in which double substitution (exchange) occurs between the ions (radicals) of two different compounds to give two other new compounds.



A Reaction between an acid and an alkali (Neutralization reaction)

Neutralization reaction

It is a reaction between an acid and an alkali to form salt and water.



- ★ **Example:** Reaction between hydrochloric acid and sodium hydroxide to form sodium chloride (salt) and water.



NOTES

On heating the products (resultants) of the previous reaction, H₂O evaporates and NaCl (table salt) remains.

B Reaction between an acid and a salt

- ★ Acid reacts with salts and the resultant depends on the type of both the acid and salt.
- ★ **Example:** Diluted hydrochloric acid reacts with sodium carbonate salt forming sodium chloride, water and carbon dioxide gas evolves which turbids clear limewater and causes an effervescence inside the flask.



C Reaction between two salt solutions

- ★ The reaction between two salt solutions is accompanied by formation of a precipitate (ppt.) [a salt doesn't dissolve in water].
- ★ **Example:** Sodium chloride solution reacts with silver nitrate solution to give sodium nitrate solution and a white precipitate of silver chloride.



GIVE REASON

- 1 A white precipitate is formed on adding silver nitrate solution in sodium chloride solution.**

Due to formation of silver chloride salt which doesn't dissolve in water.



WHAT HAPPENS WHEN

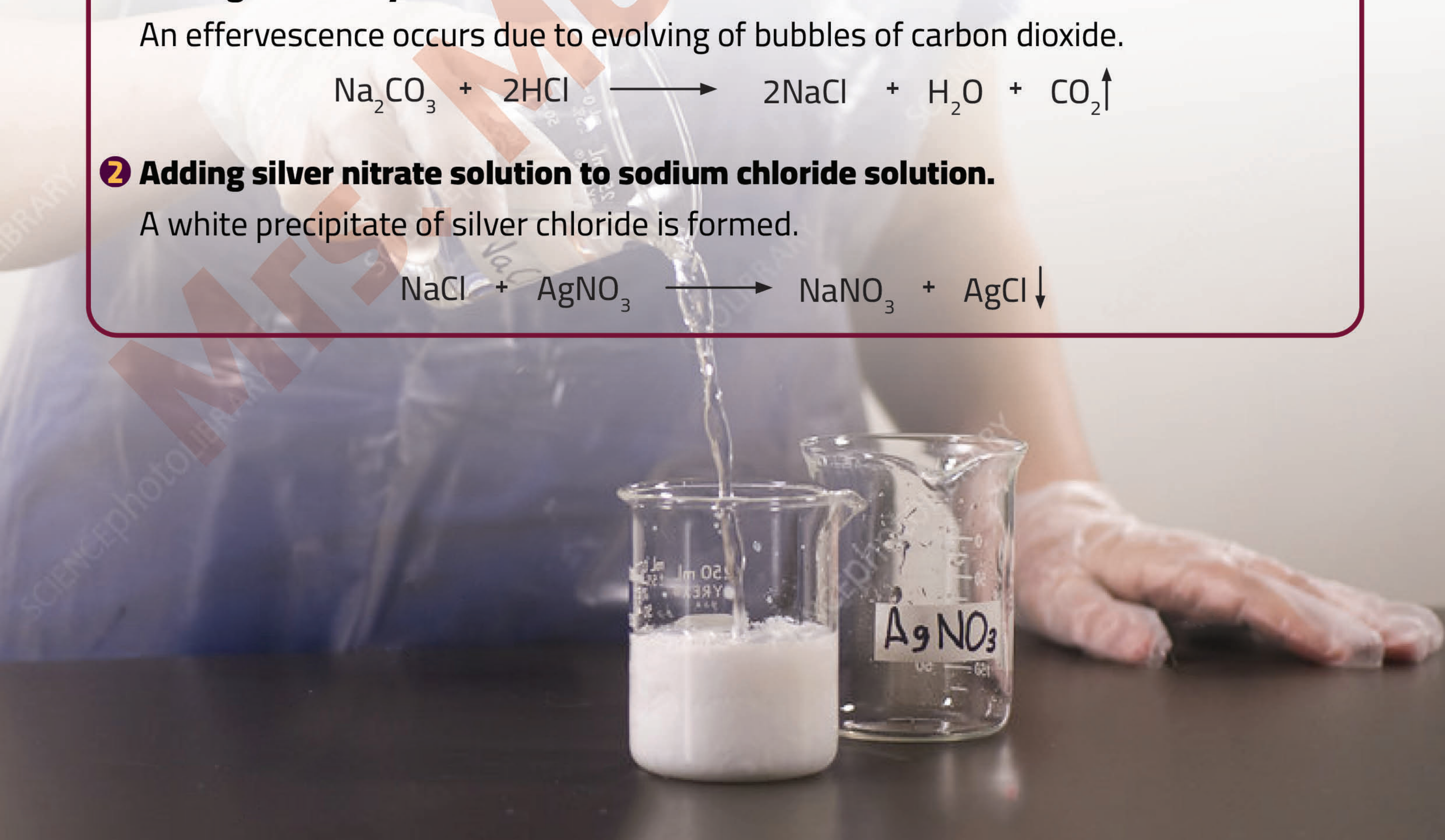
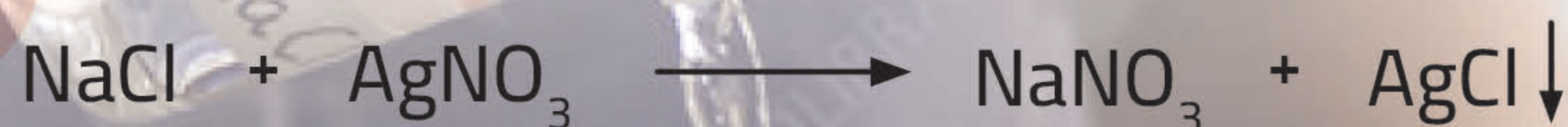
- 1 Adding diluted hydrochloric acid to sodium carbonate salt.**

An effervescence occurs due to evolving of bubbles of carbon dioxide.



- 2 Adding silver nitrate solution to sodium chloride solution.**

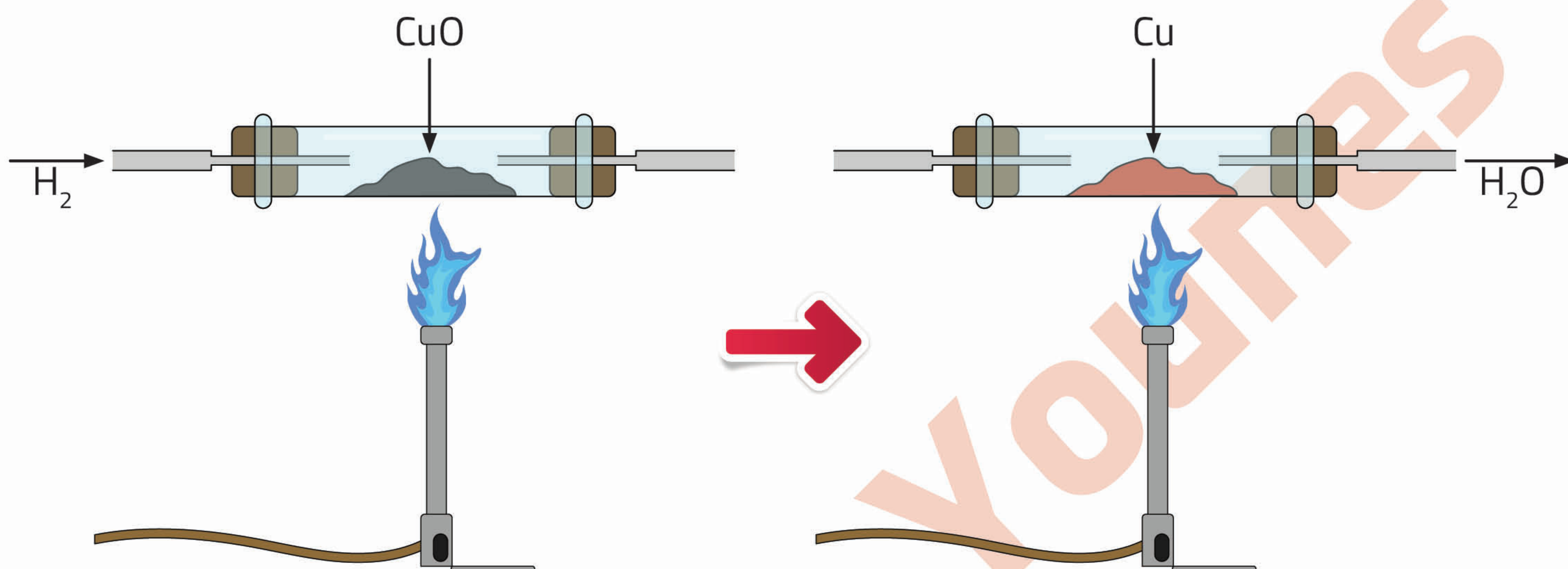
A white precipitate of silver chloride is formed.



Third: Oxidation and reduction reactions

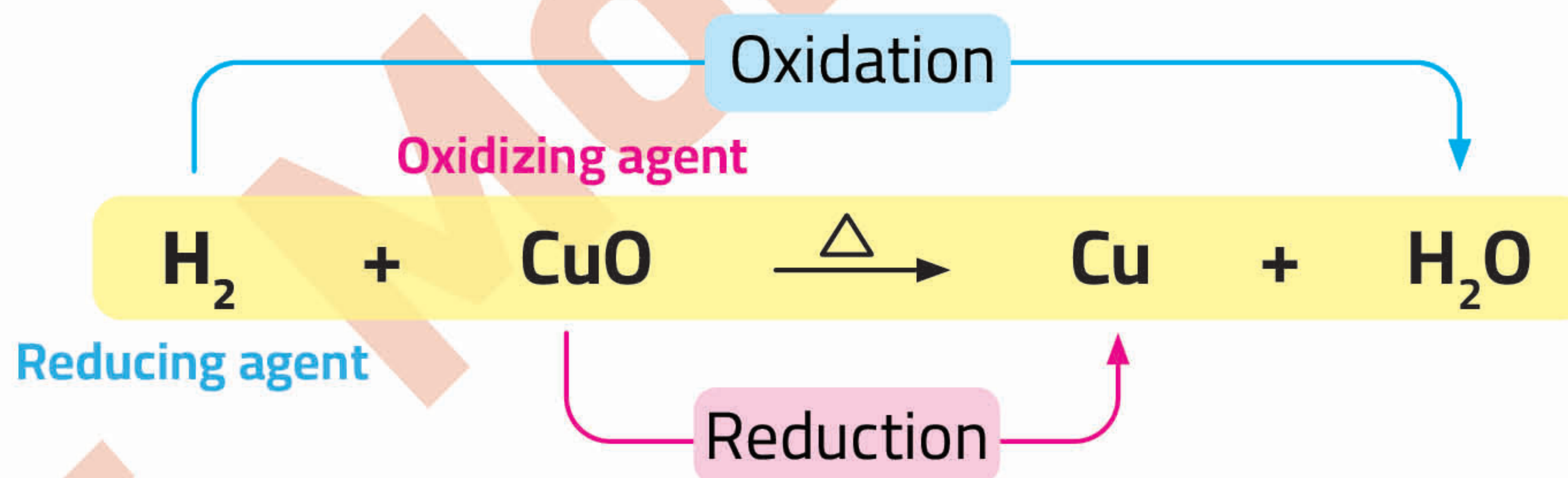
1 According to the traditional concept

Reaction of hot copper oxide with dry hydrogen gas



★ On passing hydrogen through hot copper hydroxide:

1. Hydrogen takes the oxygen away from copper oxide. **Hydrogen is oxidized into water.**
2. Black copper oxide turns into red copper. **Copper oxide is reduced into copper.**



Reducing agent (factor)

It is the substance which **takes oxygen** away or **gives hydrogen** during a chemical reaction.

Oxidizing agent (factor)

It is the substance which **gives oxygen** or **takes hydrogen** away during a chemical reaction.

Oxidation

A chemical process which causes the **increase** in the **oxygen** percentage or the **decrease** in the **hydrogen** percentage in a substance.

Reduction

A chemical process which causes the **decrease** in the **oxygen** percentage or the **increase** in the **hydrogen** percentage in a substance.

Hydrogen

- ❑ An **oxidation process** occurs to **hydrogen**.
Because it combines (unites) with oxygen.
- ❑ **Hydrogen** is considered as a **reducing agent**.
Because it took oxygen away from copper oxide.

Copper oxide

- ❑ A **reduction process** occurs to **copper oxide**.
Because oxygen is taken away from it.
- ❑ **Copper oxide** is considered as an **oxidizing agent**.
Because it gave oxygen to hydrogen.

GIVE REASON

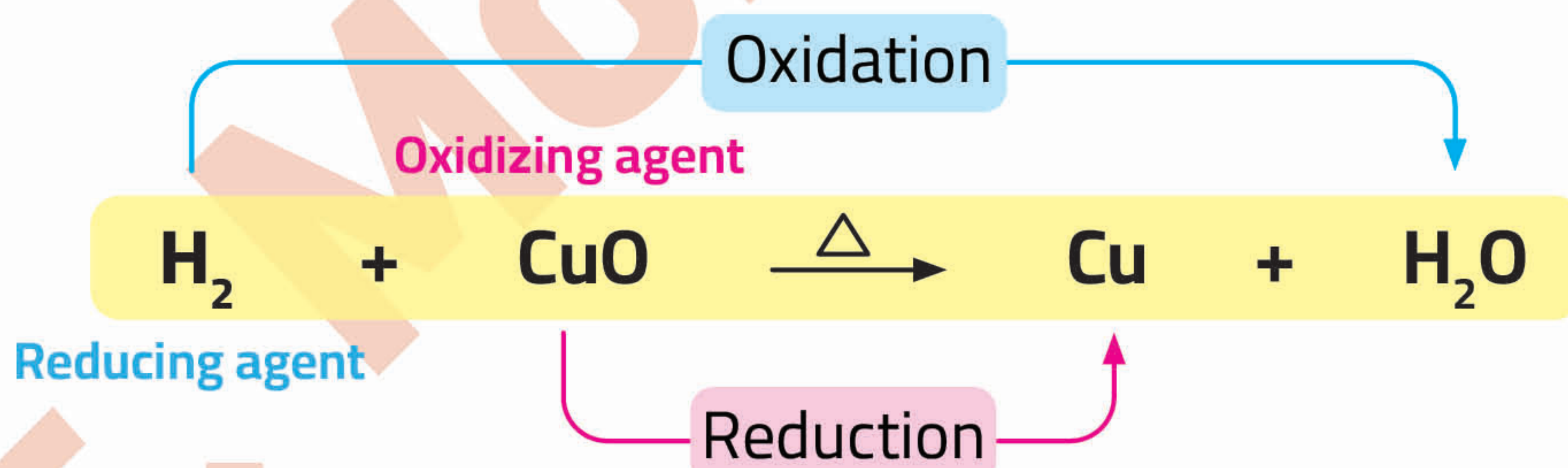
- In the reaction: $\text{H}_2 + \text{CuO} \longrightarrow \text{Cu} + \text{H}_2\text{O}$ hydrogen is considered as a **reducing agent**, while copper oxide is considered as an **oxidizing agent**.

Because hydrogen **takes oxygen** and **reduces** copper oxide to copper, while copper oxide **gives oxygen** and **oxidizes** hydrogen to water.

WHAT HAPPENS WHEN

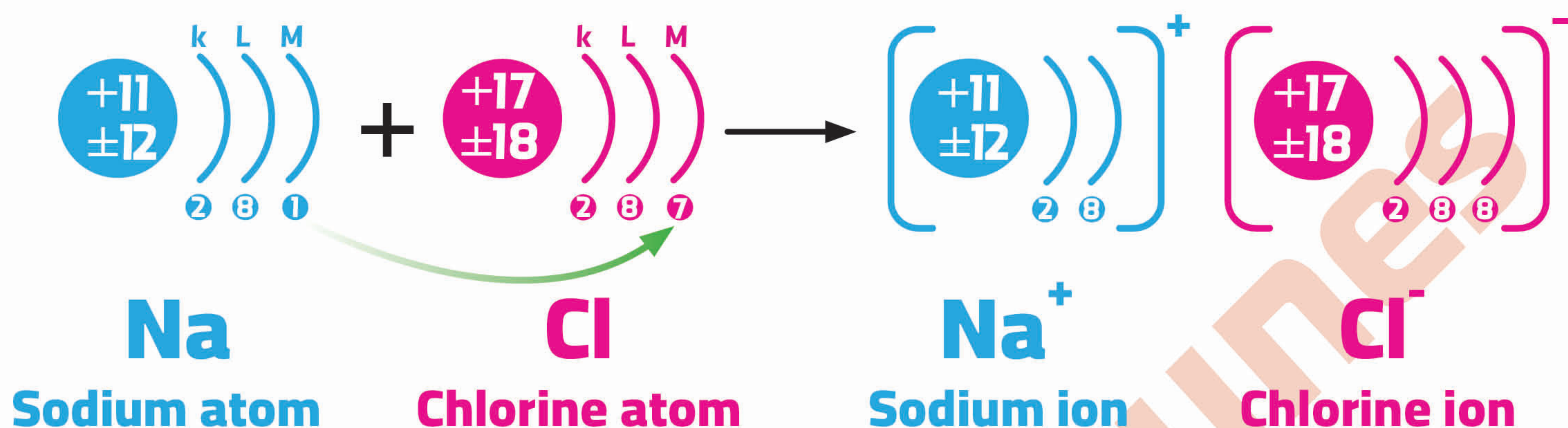
- Passing hydrogen gas over hot copper oxide.

Hydrogen is oxidized into water, while copper oxide is reduced into copper.

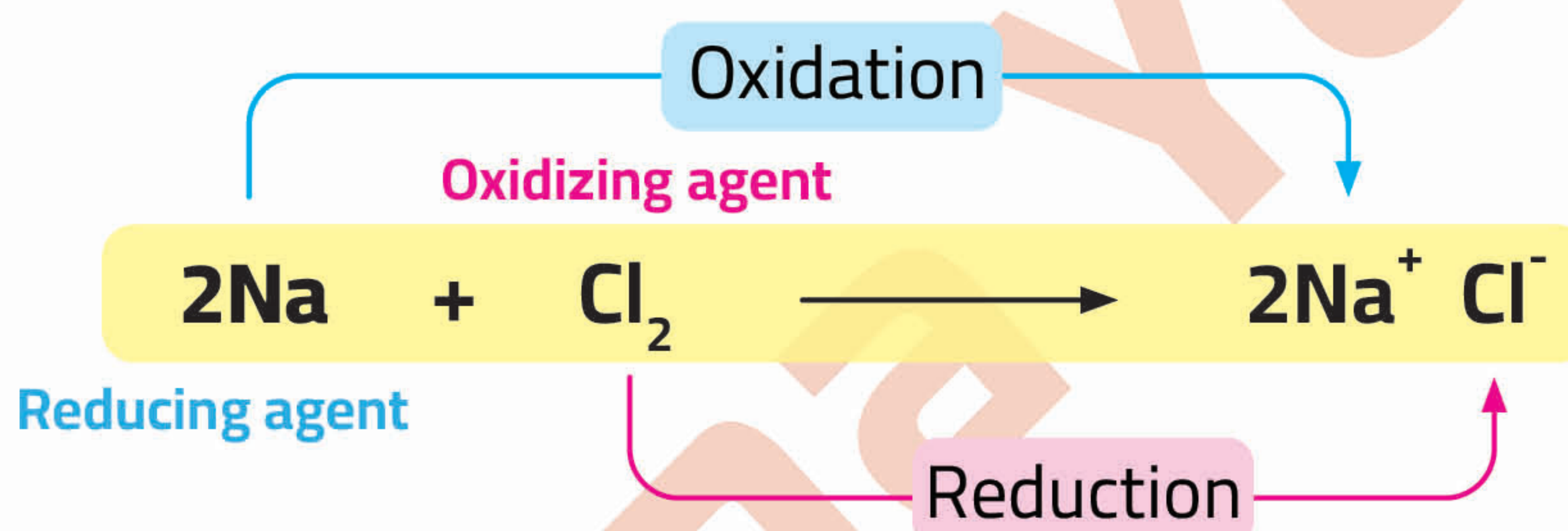


2 According to the electronic concept

1 Reaction of sodium atom and chlorine atom to form sodium chloride molecule



★ The previous reaction is expressed by the following equation:



Reducing agent (factor)

It is the substance which **loses** an **electron** or more during a chemical reaction.

Oxidation

A chemical process where the atom **loses** an electron or more.

Sodium

- ❑ **An oxidation process** occurs to **sodium**. Because it **loses** an **electron** and changes into a positive sodium ion.



- ❑ **Sodium** is a **reducing agent**. Because it **loses** an **electron** during the chemical reaction and changes into a **positive sodium ion**.

Oxidizing agent (factor)

It is the substance which **gains** an **electron** or more during a chemical reaction.

Reduction

A chemical process where the atom **gains** an electron or more.

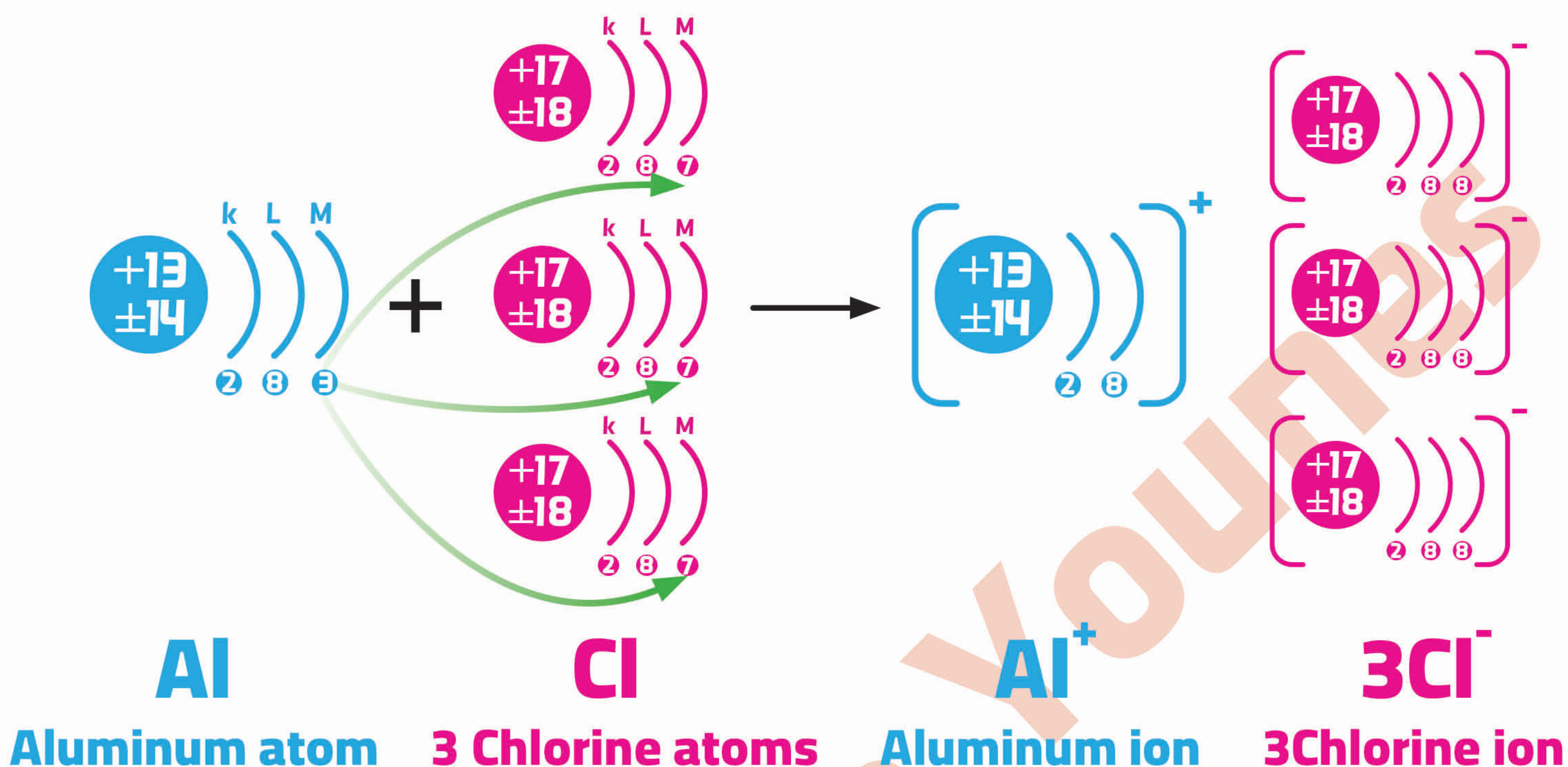
Chlorine

- ❑ **A reduction process** occurs to **chlorine**. Because it **gains** an **electron** and changes into a **negative chloride ion**.

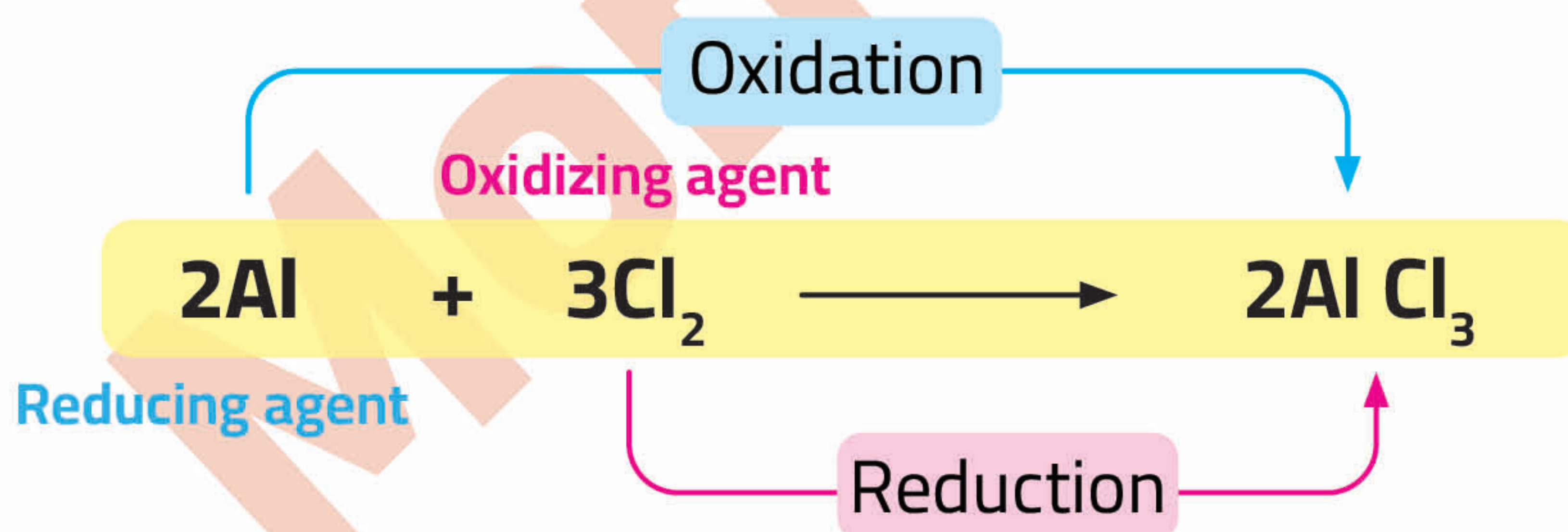


- ❑ **Chlorine** is an **oxidizing agent**. Because it **gains** an **electron** during the chemical reaction and changes into a **negative chloride ion**.

2 Reaction of aluminum atom and chlorine atom to form aluminum chloride molecule



★ The previous reaction is expressed by the following equation:



Aluminum

❑ **An oxidation process** occurs to **aluminum**. Because it **loses 3 electrons** and changes into a positive aluminum ion.



❑ **Aluminum** is a **reducing agent**. Because it **loses** an **3 electrons** during the chemical reaction and changes into a **positive aluminum ion**.

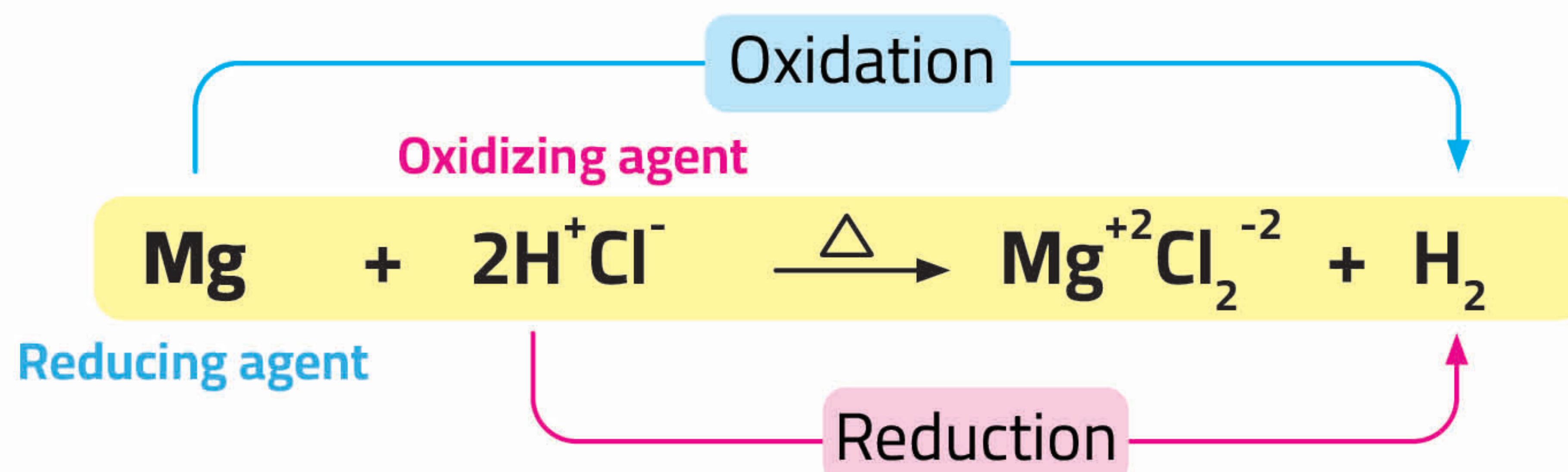
Chlorine

❑ **A reduction process** occurs to **chlorine**. Because it **gains** an **electron** and changes into a **negative chloride ion**.



❑ **Chlorine** is an **oxidizing agent**. Because it **gains** an **electron** during the chemical reaction and changes into a **negative chloride ion**.

3 Reaction of magnesium atom and hydrochloric acid



Magnesium

- An **oxidation process** occurs to **magnesium**. Because it **loses 2 electrons** and changes into a positive aluminum ion.



- **Magnesium** is a **reducing agent**. Because it **loses an 2 electrons** during the chemical reaction and changes into a **positive magnesium ion**.

Hydrogen ion

- A **reduction process** occurs to **hydrogen ion**. Because it **gains an electron** and changes into **hydrogen molecule**.



- **Hydrogen ion** is an **oxidizing agent**. Because it **gains an electron** during the chemical reaction and changes into a **hydrogen molecule**.

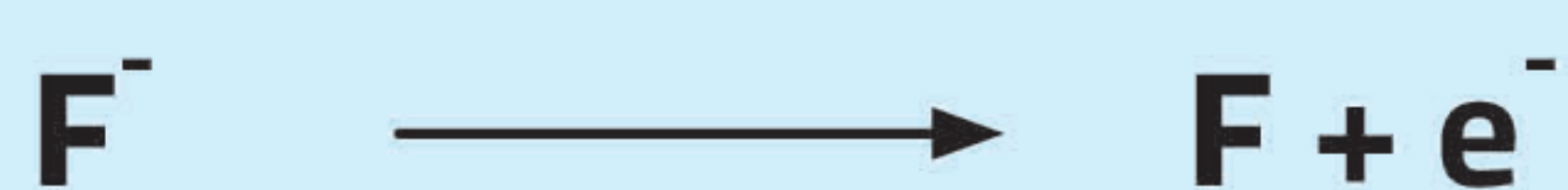
NOTES

Any chemical process includes:

Oxidation

Losing of electrons is known as an oxidation process.

Examples



Reduction

Gaining of electrons is known as a reduction process.



GIVE REASON

- 1 **Oxidation and reduction are concurrent processes as they occur at the same time.** Because the number of gained electrons in reduction process equals the number of lost electrons in oxidation process.

2 Most metals are strong reducing agents, while most nonmetals are strong oxidizing agents.

Because metals tend to lose electrons during the chemical reaction, while nonmetals tend to gain electrons during the chemical reaction.

3 In the reaction: $2\text{Na} + \text{Cl}_2 \longrightarrow 2\text{NaCl}$ sodium is considered as a reducing agent, while chlorine is considered as an oxidizing agent.

Because sodium atom loses an electron and changes into a positive ion, while chlorine atom gains an electron and changes into a negative ion.

4 On the reaction between sodium with chlorine to form sodium chloride, oxidation and reduction processes occur, although absence of oxygen.

Because this reaction occurs by losing and gaining electrons.

WHAT HAPPENS WHEN

1 Sodium atom loses an electron during the chemical reaction.

It is oxidized and changes into a positive sodium ion and it became a reducing agent.



2 Chlorine atom gains an electron during the chemical reaction.

It is reduced and changes into a negative chlorine ion and it became an oxidizing agent.



Reducing agent (factor)

1. It is the substance which **takes oxygen** away or **gives hydrogen** during a chemical reaction.
2. It is the substance which **loses an electron** or more during a chemical reaction.

Oxidizing agent (factor)

1. It is the substance which **gives oxygen** or **takes hydrogen** away during a chemical reaction.
2. It is the substance which **gains an electron** or more during a chemical reaction.

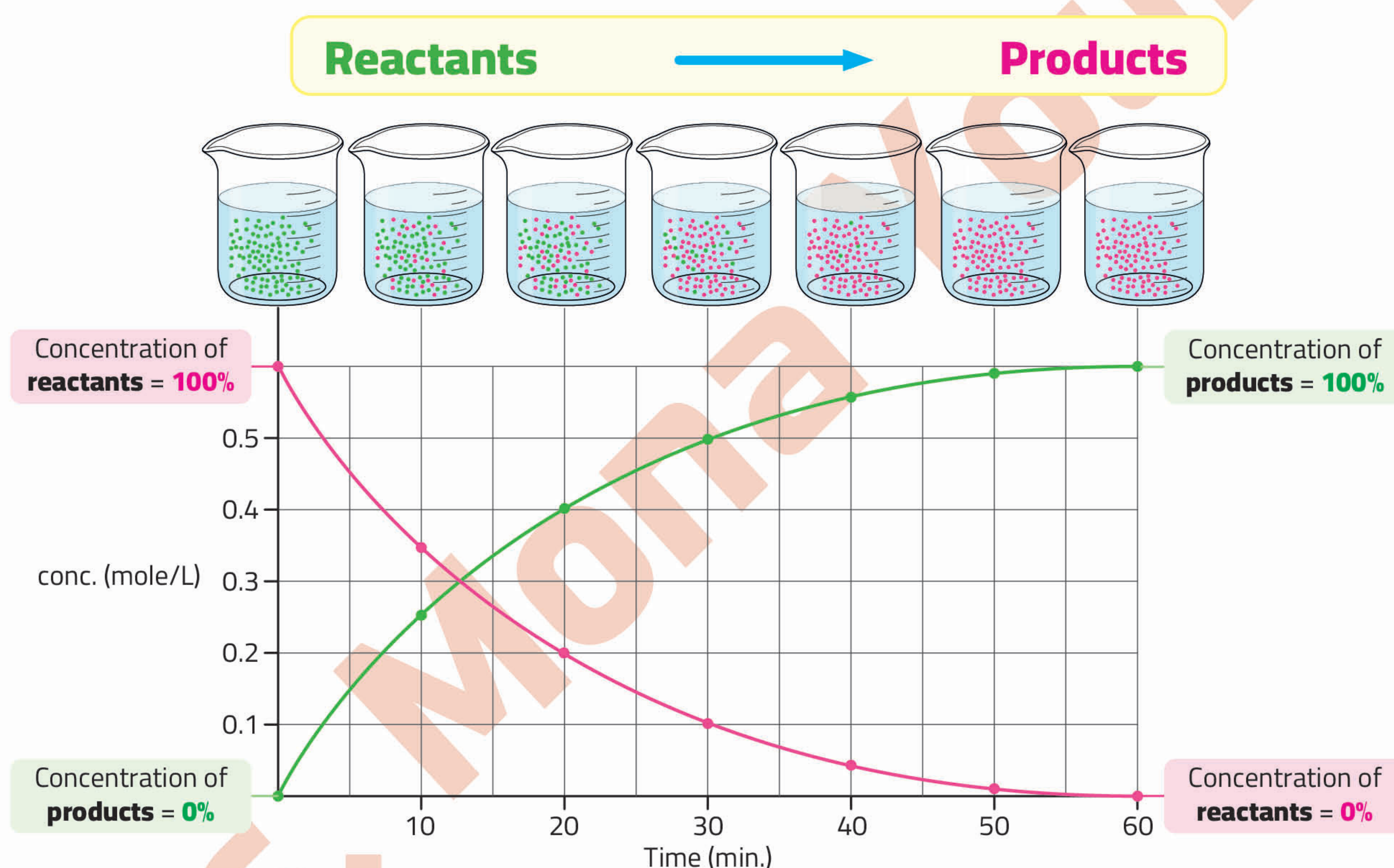
	Oxidation	Reduction
Traditional concept	A chemical process which causes the increase in the oxygen percentage or the decrease in the hydrogen percentage in a substance. $\text{H}_2 \longrightarrow \text{H}_2\text{O}$	A chemical process which causes the decrease in the oxygen percentage or the increase in the hydrogen percentage in a substance. $\text{CuO} \longrightarrow \text{Cu}$
Electronic concept	A chemical process where the atom loses an electron or more. $\text{Na} \longrightarrow \text{Na}^+ + 2\text{e}^-$	A chemical process where the atom gains an electron or more. $\text{Cl}_2 + 2\text{e}^- \longrightarrow 2\text{Cl}^-$
	Simple substitution reactions	Double substitution reactions
Definition	They are chemical reactions in which one of the elements substitutes another less active element in a solution of one of its compounds.	They are chemical reactions in which double substitution (exchange) occurs between the ions (radicals) of two different compounds to give two other new compounds.
Types	1. A metal substitutes the hydrogen of water. 2. A metal substitutes the hydrogen of diluted acids. 3. A metal substitutes another one in its salt solution.	1. An acid with an alkali. 2. An acid with a salt. 3. A salt solution with another salt solution.



★ **Chemical reactions differ in the speed of their occurrence:**

Chemical Reaction	The speed of its occurrence
☐ Reaction of fireworks.	☐ Very fast (very short time).
☐ Reaction of oil with caustic soda to form soap.	☐ Relatively slow (short time).
☐ Reaction of rusting of iron.	☐ Very slow (several months).
☐ Reaction of formation of petroleum oil inside Earth.	☐ Too slow (millions of years).

The concept of the speed of a chemical reaction



	Concentration of reactants	Concentration of products
At the beginning of the reaction	is the largest (100%)	is the smallest (0%)
By passing time	decreases	increases
At the end of the reaction	is the smallest (0%)	is the largest (100%)

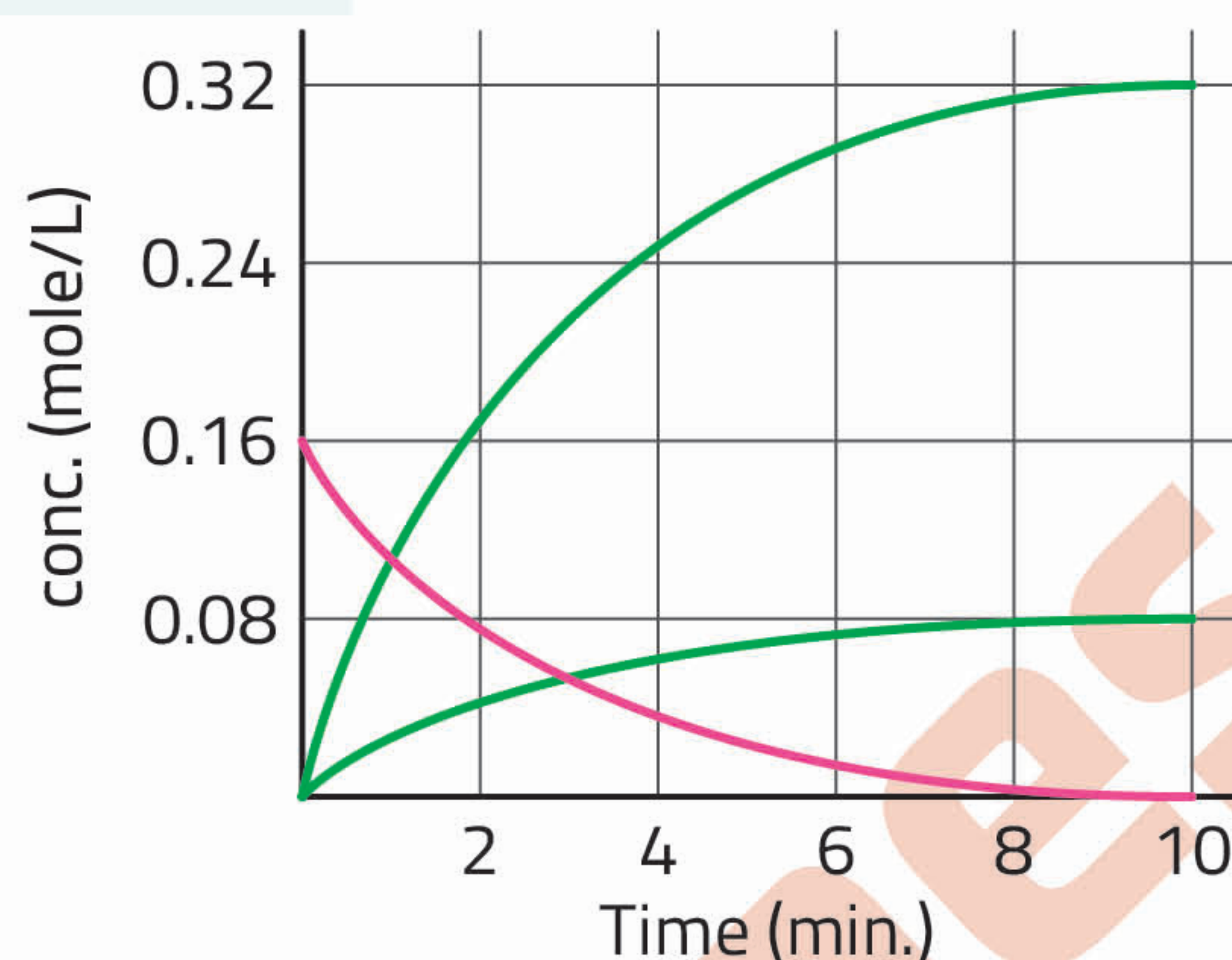
The speed of a chemical reaction

It is the change in the concentration of the reactants and the products in a unit time.

Application

The speed of decomposition (dissociation) of nitrogen pentoxide (N_2O_5)

- ★ Nitrogen pentoxide decomposes (breaks up) into nitrogen dioxide and oxygen gas.



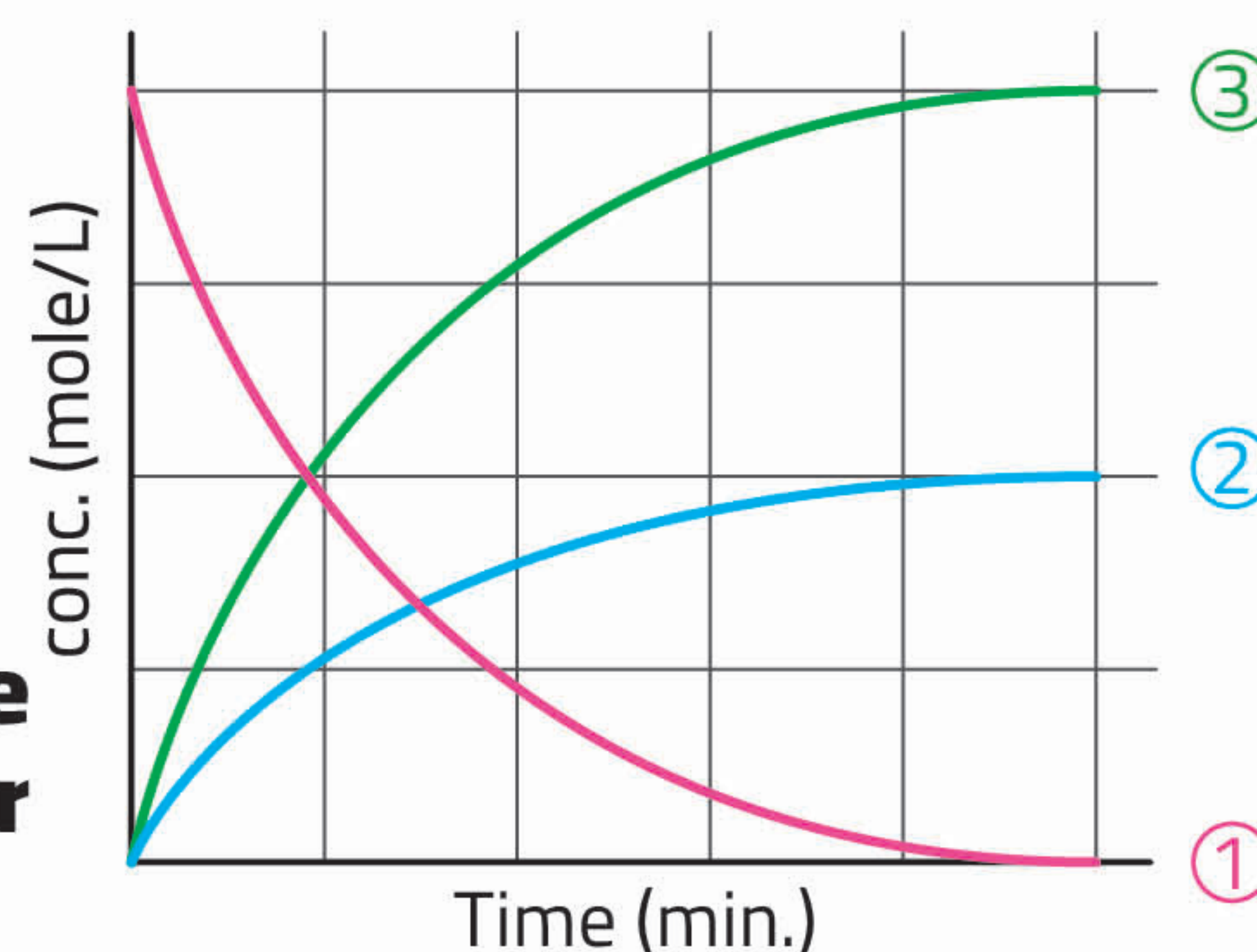
	Concentration of reactants N_2O_5	Concentration of products NO_2 & O_2
At the beginning of the reaction	is the largest (100%)	is the smallest (0%)
By passing time	decreases	increases
At the end of the reaction	is the smallest (0%)	is the largest (100%)

Example 1

The opposite graph represents the breaking up of the compound X as in the following equation:



Replace the numbers shown on the figure with the suitable substances X, Y, Z and give reason for your answers.

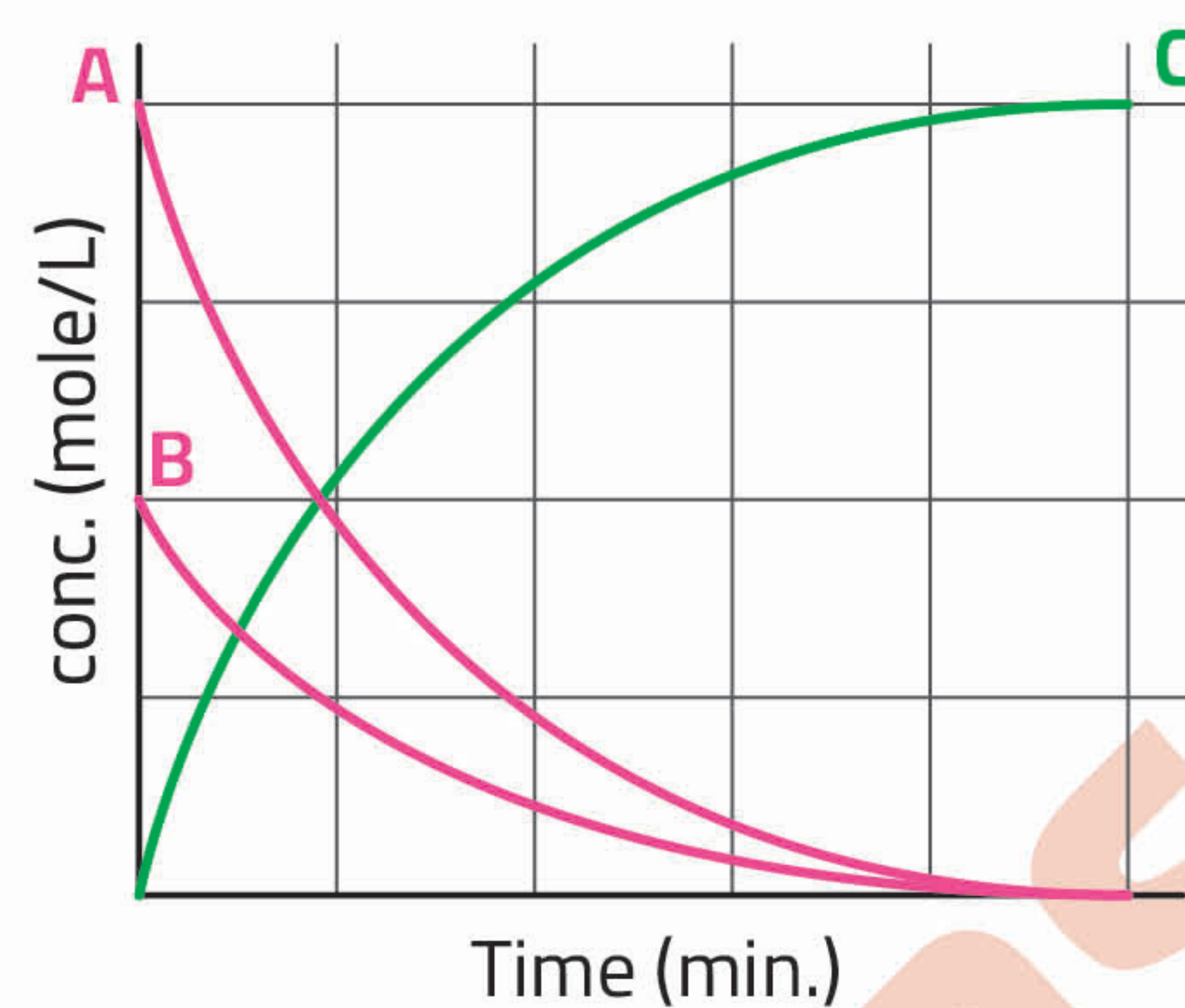


	Substance	Reason
①	X	Because it represents the reactant, where its concentration at: - the beginning of the reaction is 100%. - the end of the reaction is 0%.
②	Z	Because it represents the resultants, where their concentration at: - the beginning of the reaction is 100%. - the end of the reaction is 0%.
③	Y	∴ The number of moles of substance ($\text{Y} > \text{Z}$). ∴ It must be the concentration of substance ($\text{Y} > \text{Z}$) in the graph.

Example 2

The opposite graph represents the relation between (concentration - time) for a certain reaction.

Write the symbolic equation for this reaction.



At the beginning of the reaction

Reactants

∴ The concentration of the two substances A and B is the greatest.

∴ The two substances A and B represent the reactants.

∴ The concentration of the substance A is double the concentration of substance B

∴ The reactants are written as $2A + B$

Products

∴ The concentration of the two substances A and B is the smallest.

∴ The substance C represents the products.

∴ The concentration of the substance C = the concentration of the substance A.

∴ The products are written as $2C$.

Measuring the speed of the chemical reaction

★ The speed of a chemical reaction can be measured practically by the rate of:

☐ Disappearance of one of the reactants.

Or

☐ Apperance of one of the resultants.

Application

The rate of reaction of sodium hydroxide solution with copper sulphate solution

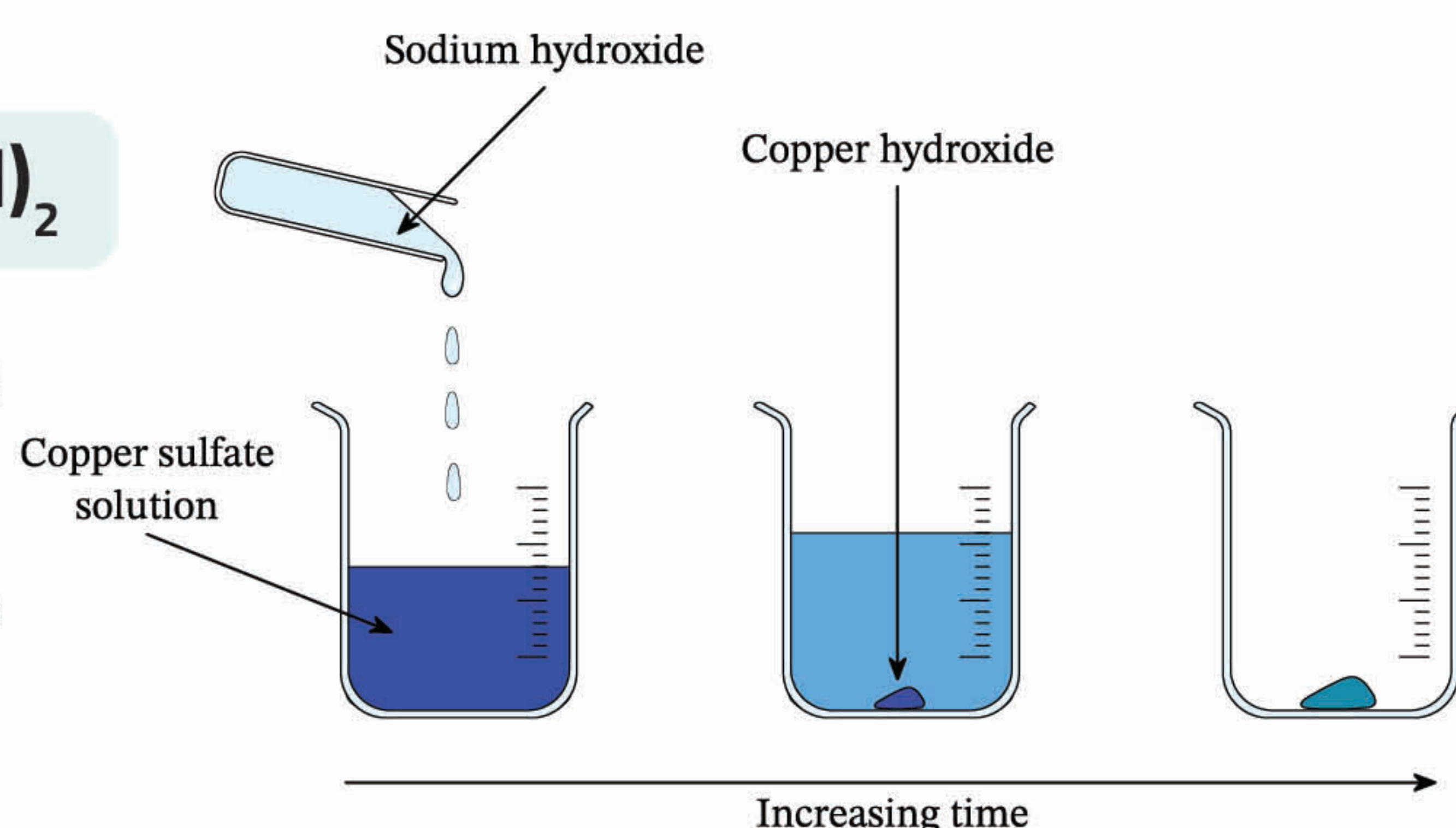


★ The speed of a chemical reaction can be measured practically by the rate of:

☐ Disappearance rate of the blue color of copper sulphate solution (reactant).

Or

☐ Formation rate of the blue color precipitate of copper hydroxide (resultant).



Factors affecting the speed of chemical reaction

1 The nature of the reactants

A The kind of bonding in reactants

Ionic compounds

The reactions of ionic compounds are fast.

Because they take place between ions, where they breakup (dissociate) completely into ions on dissolving in water.

Covalent compounds

Most of the reactions of covalent compounds are slow.

Because they take place between molecules, where they are difficult to ionize on dissolving in water.

GIVE REASON

1 The reaction between sodium chloride solution and silver nitrate solution is from fast reactions.

Because it takes place between ions that are resulted from dissociation of each of them in water.



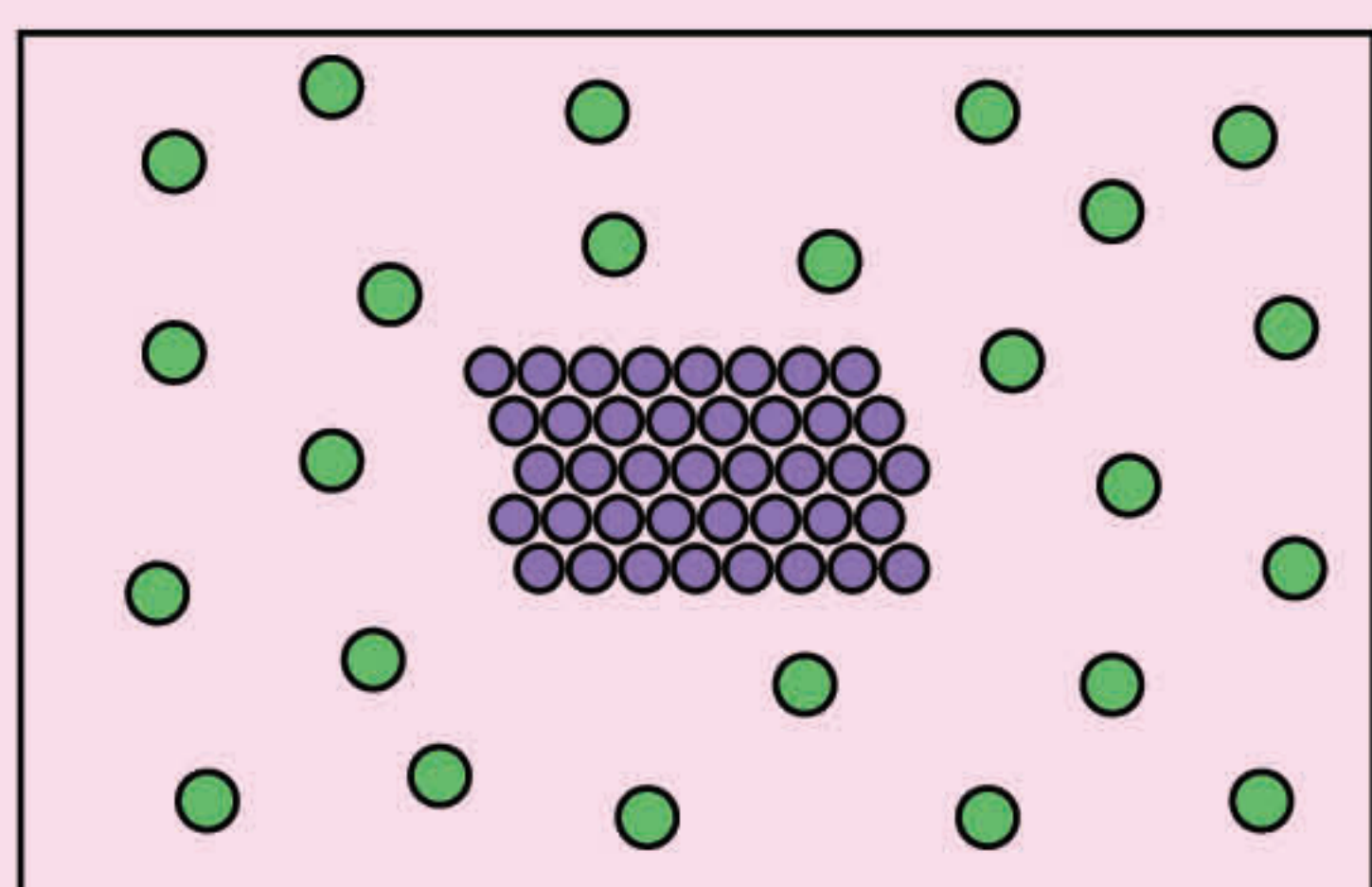
2 Reactions between ionic compounds are fast whereas, reactions between covalent compounds are slow.

Because the reactions of ionic compounds take place between ions, while the reactions of covalent compounds take place between molecules.

B The surface area of reactants exposed to reaction

Small surface area (big-sized piece)

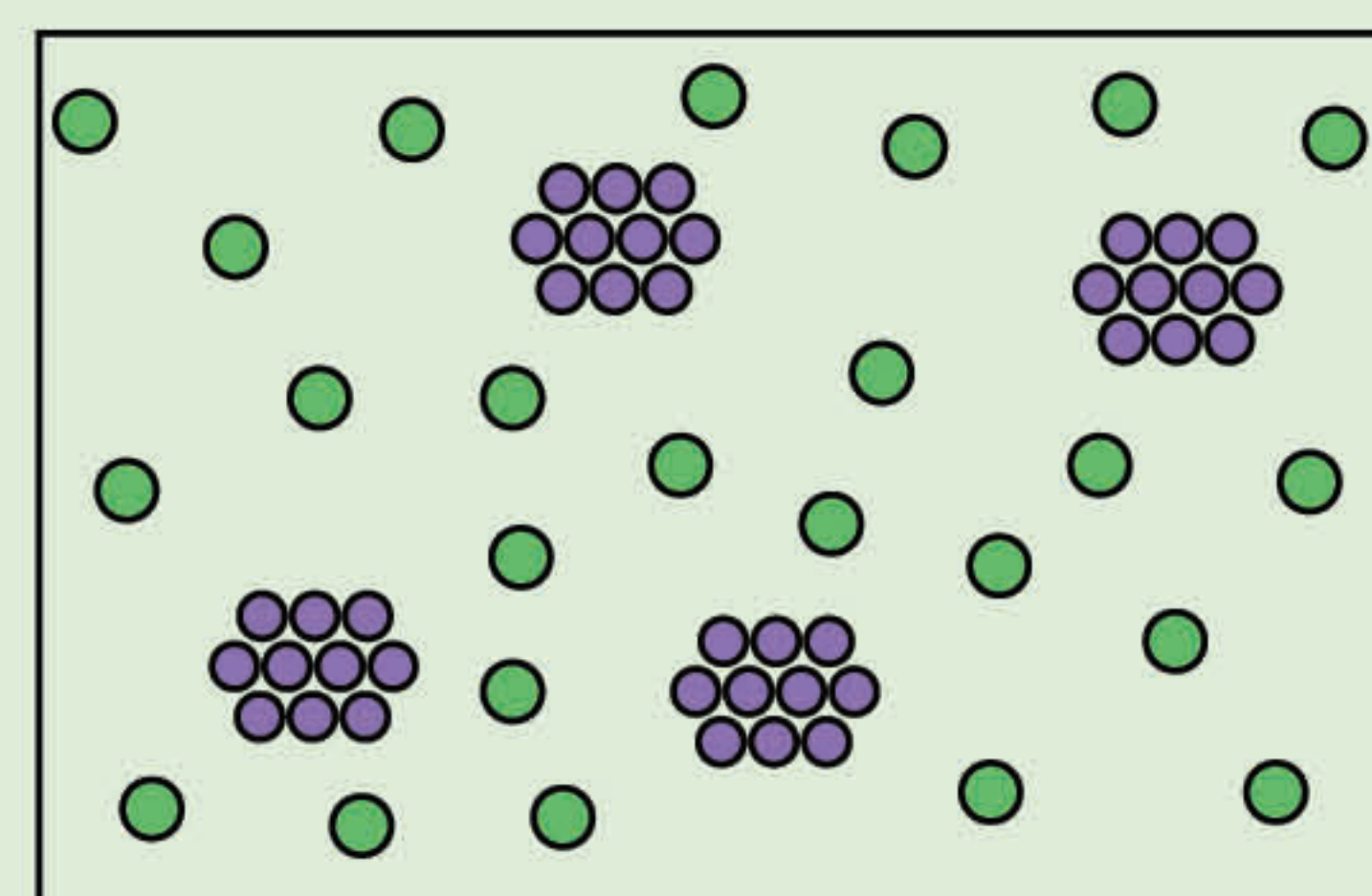
The reaction is slow.



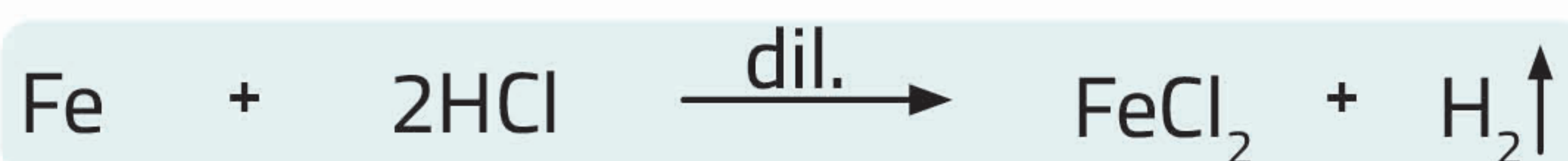
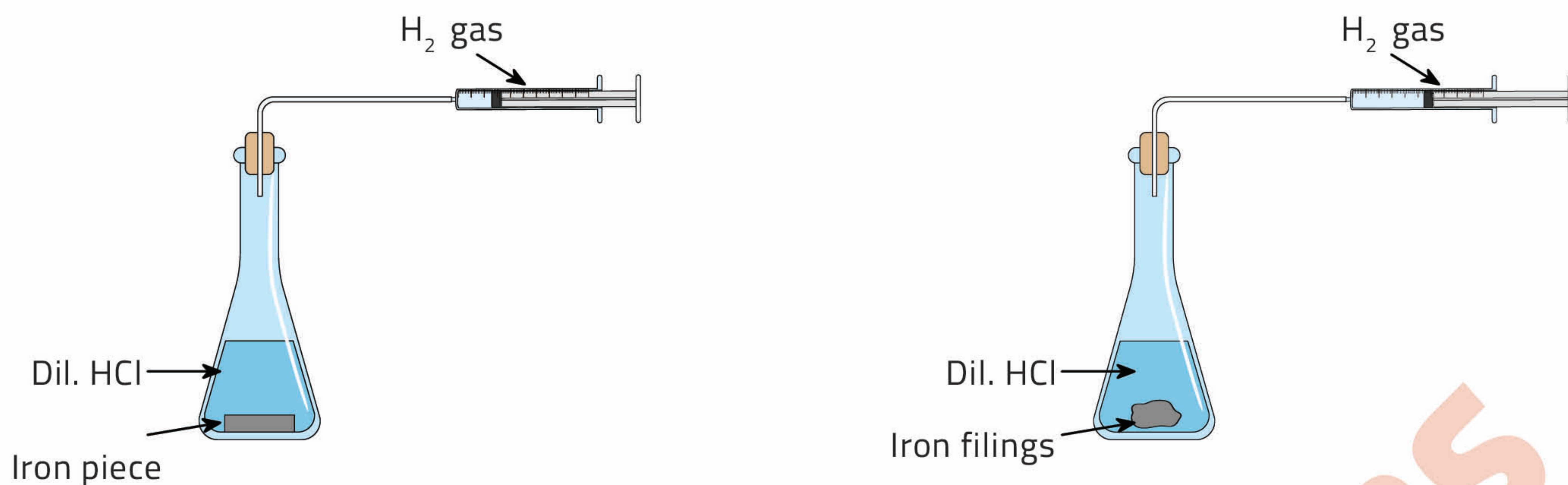
Because the surface area exposed to reaction is small.

Large surface area (powder - filings - turning)

The reaction is fast.



Because the surface area exposed to reaction is large.



- ★ The rate of reaction of hydrochloric acid with iron filings is **faster** than that in case of iron piece.
- ★ The surface area of iron filings exposed to reaction with the acid is more than the surface area of the iron piece, so the reaction in case of iron filings ends in **a short time** than that in the case of iron piece.
- ★ The speed of chemical reaction **increases** by **increasing** the surface area of the reactants exposed to reaction.

GIVE REASON

- 1 A certain mass of iron filings reacts with acids faster than the reaction of a block of iron has the same mass with acids.**

Because the surface area in case of iron filings is larger than that in case of iron block and the speed of chemical reactions increases by increasing the surface area.

- 2 Using nickel filings in hydrating oil instead of pieces of nickel.**

Because the speed of chemical reactions increases by increasing the surface area.

- 3 The speed of chemical reaction increases by increasing the surface area of the reactants exposed to the reaction.**

Due to increasing the number of molecules of reactants exposed to reaction.

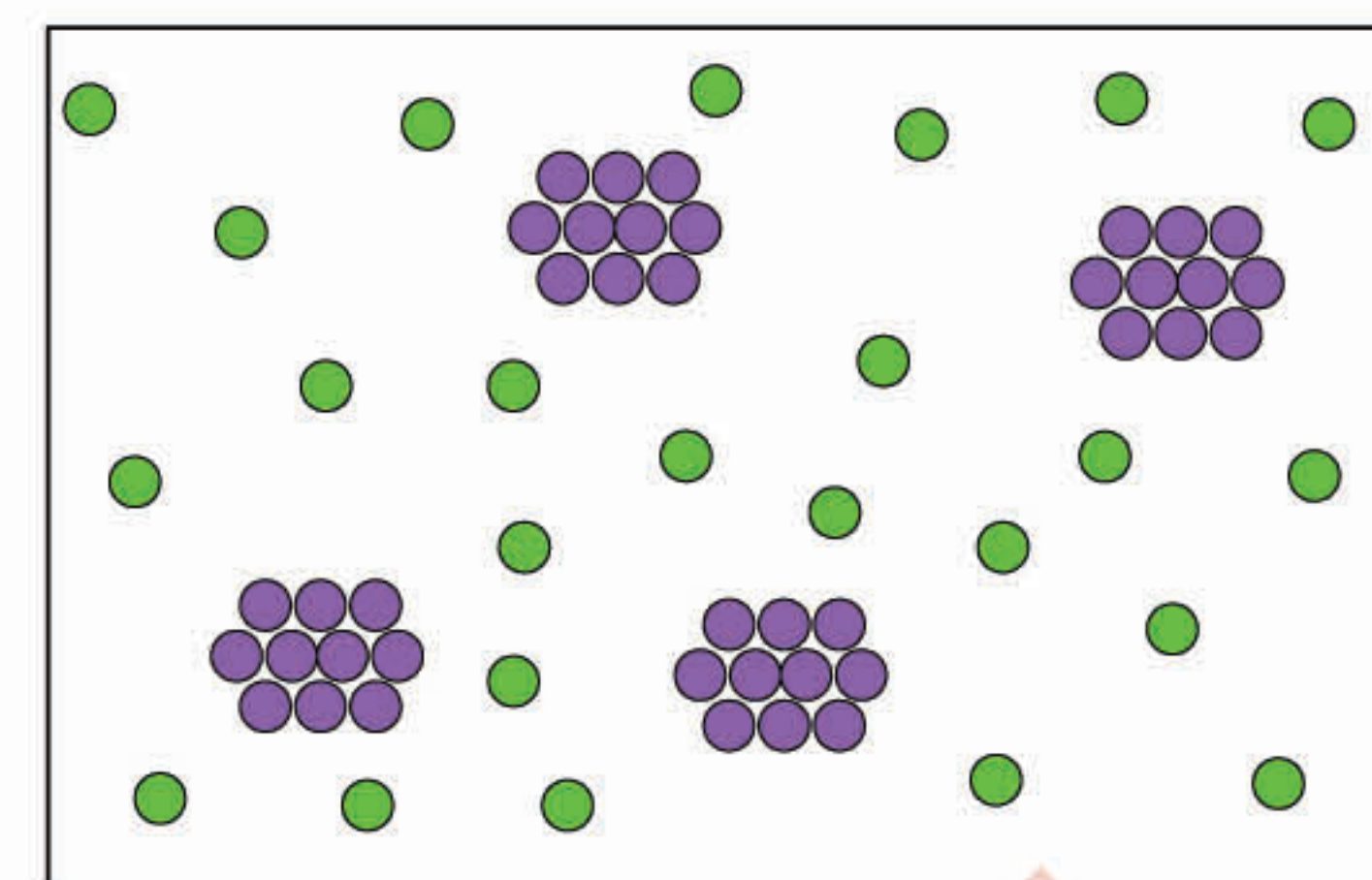
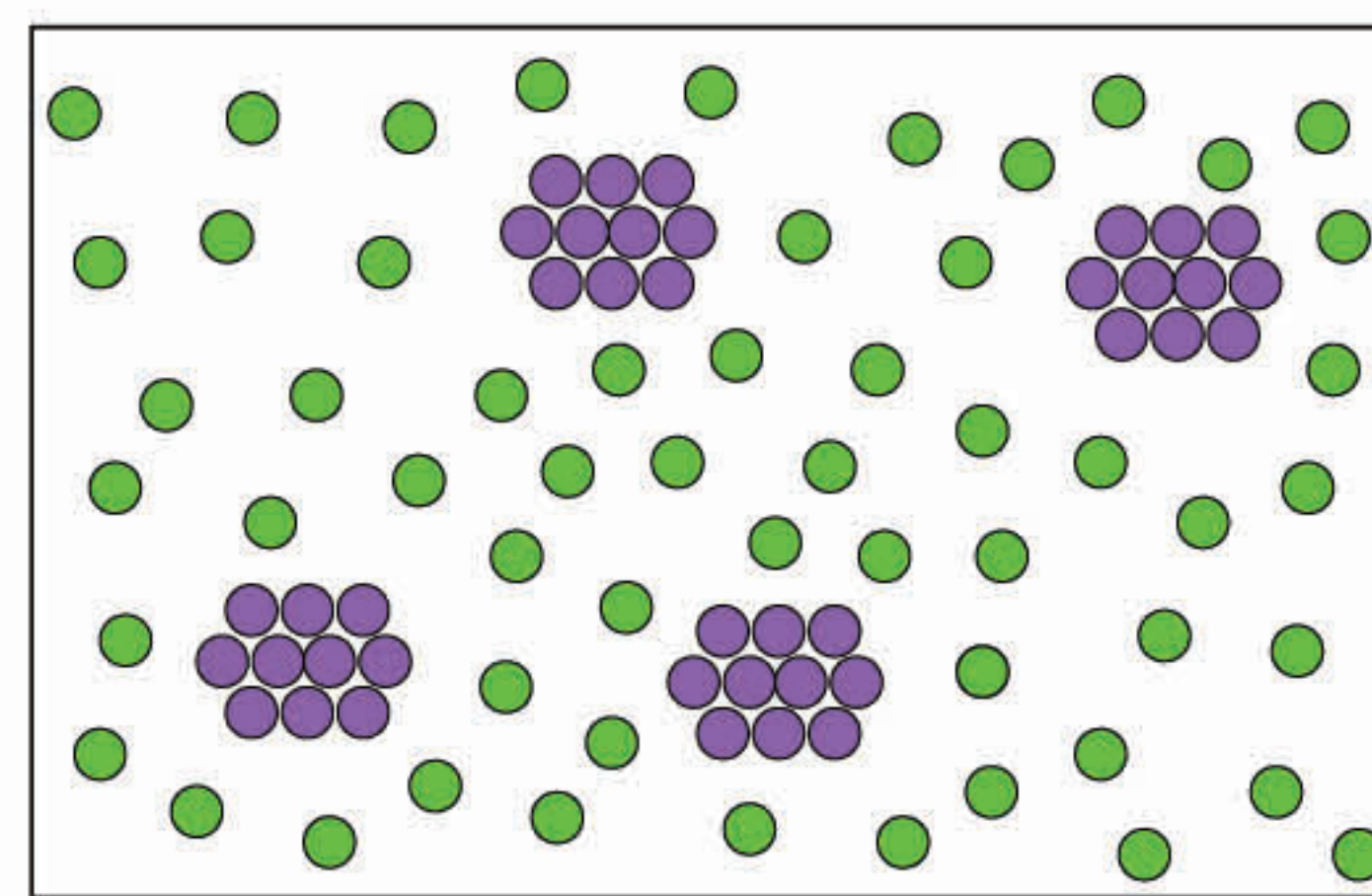
WHAT HAPPENS WHEN

- 1 Breaking up the reactants used in chemical reactions.**

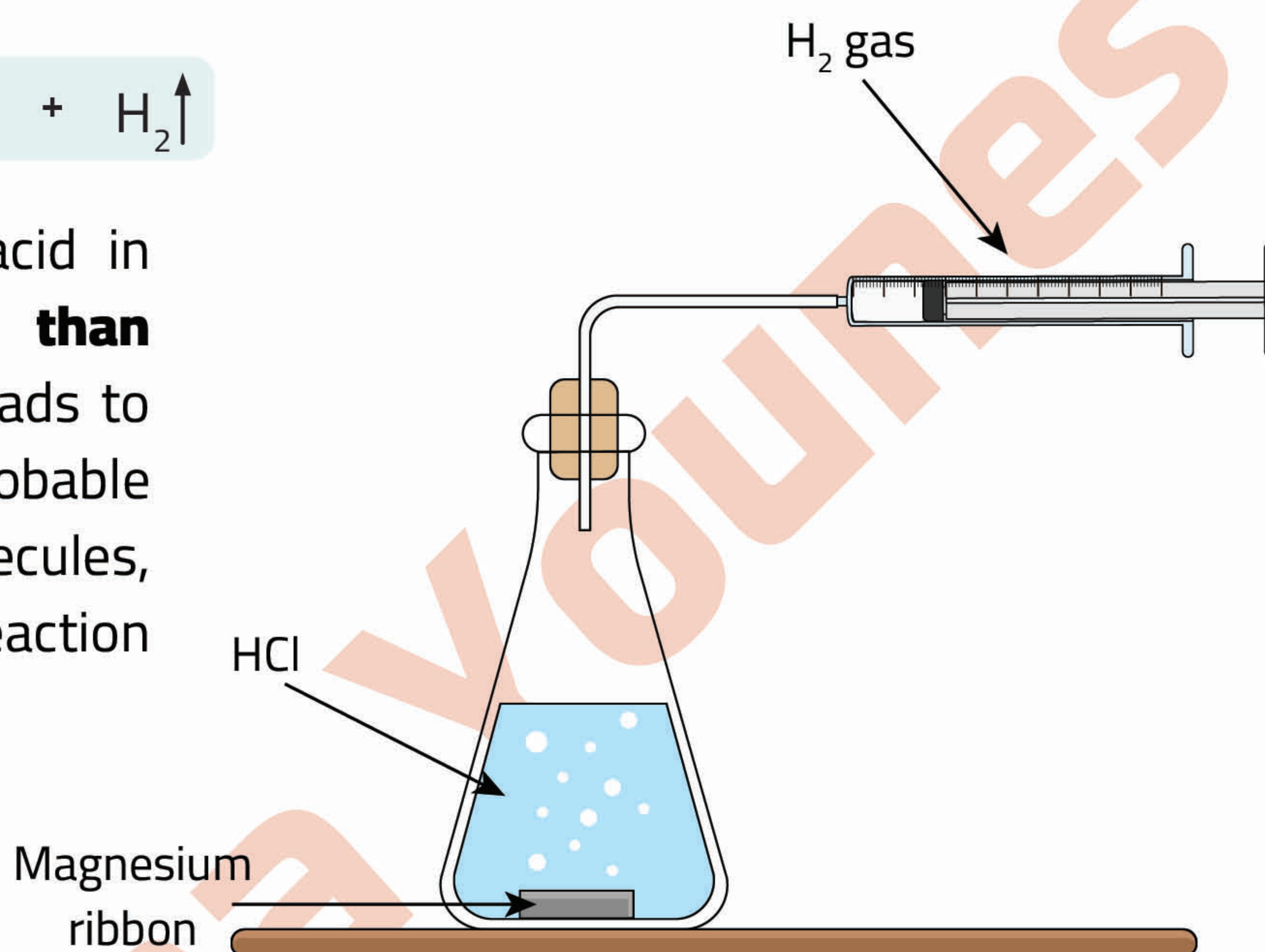
The surface area exposed to reaction increases, so the speed of chemical reactions increases.

2 The concentration of the reactants

- ★ When the concentration (no. of molecules) of the reactants **increases**, the number of **probable collisions** between molecules increases, thus the speed of chemical reaction **increases**.



- ★ The number of molecules of acid in concentrated solution is **more than** that in diluted solution which leads to **increasing** the number of probable collisions between reactant molecules, so the speed of chemical reaction **increases**.



GIVE REASON

- The speed of a chemical reaction increases by increasing the concentration of the reactants.**

Because by increasing the number of reactant molecules, the number of probable collisions between them increases.

- Combustion of the steel scourers used for cleaning aluminum pots in a jar filled with oxygen is faster than its combustion in atmospheric air.**

Due to increasing the speed of chemical reaction by increasing the concentration of the oxygen gas.

- The speed of chemical reaction increases by increasing the surface area of the reactants exposed to the reaction.**

Due to increasing the number of molecules of reactants exposed to reaction.

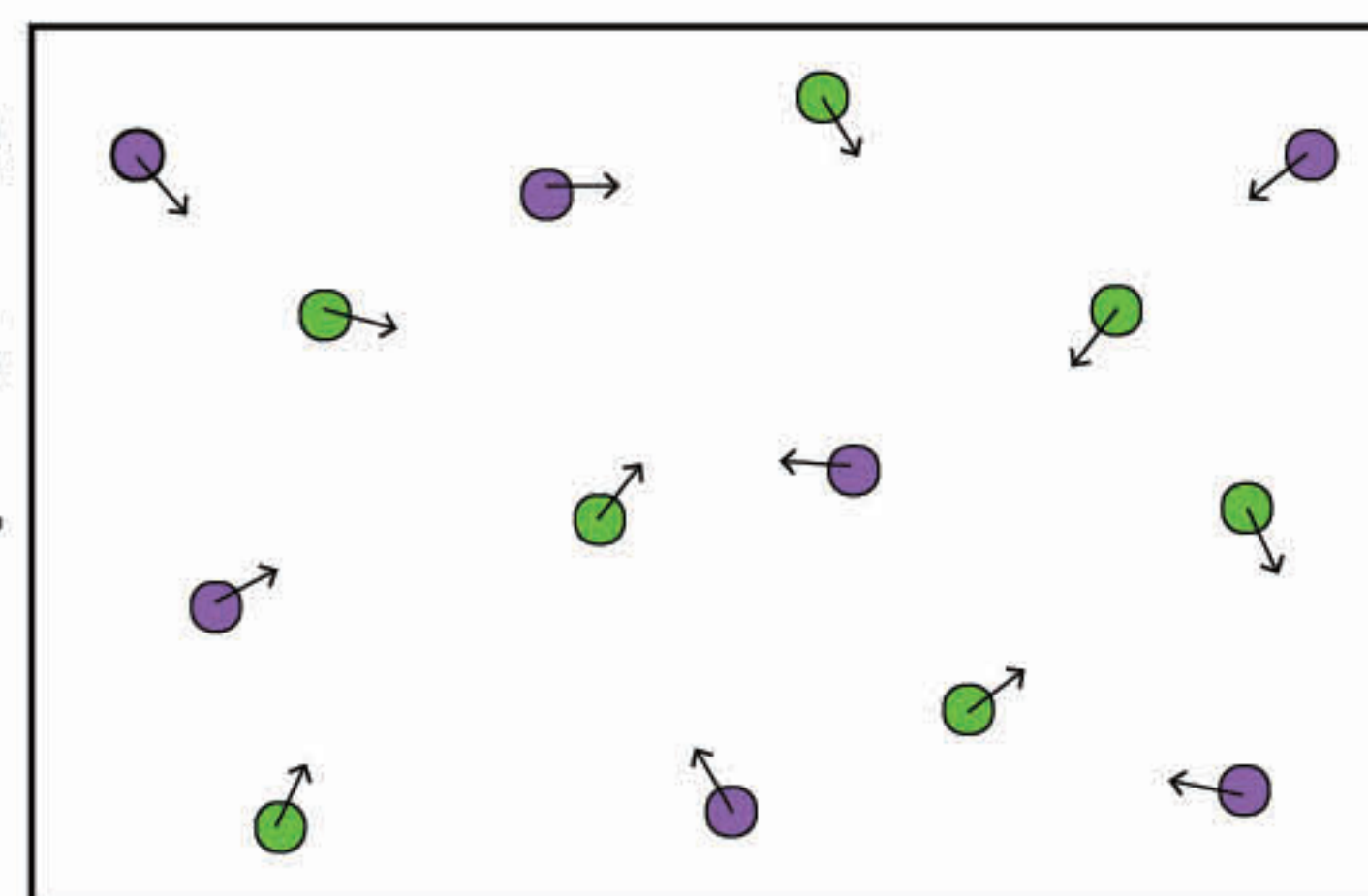
WHAT HAPPENS WHEN

- Increasing the concentration of the reactants.**

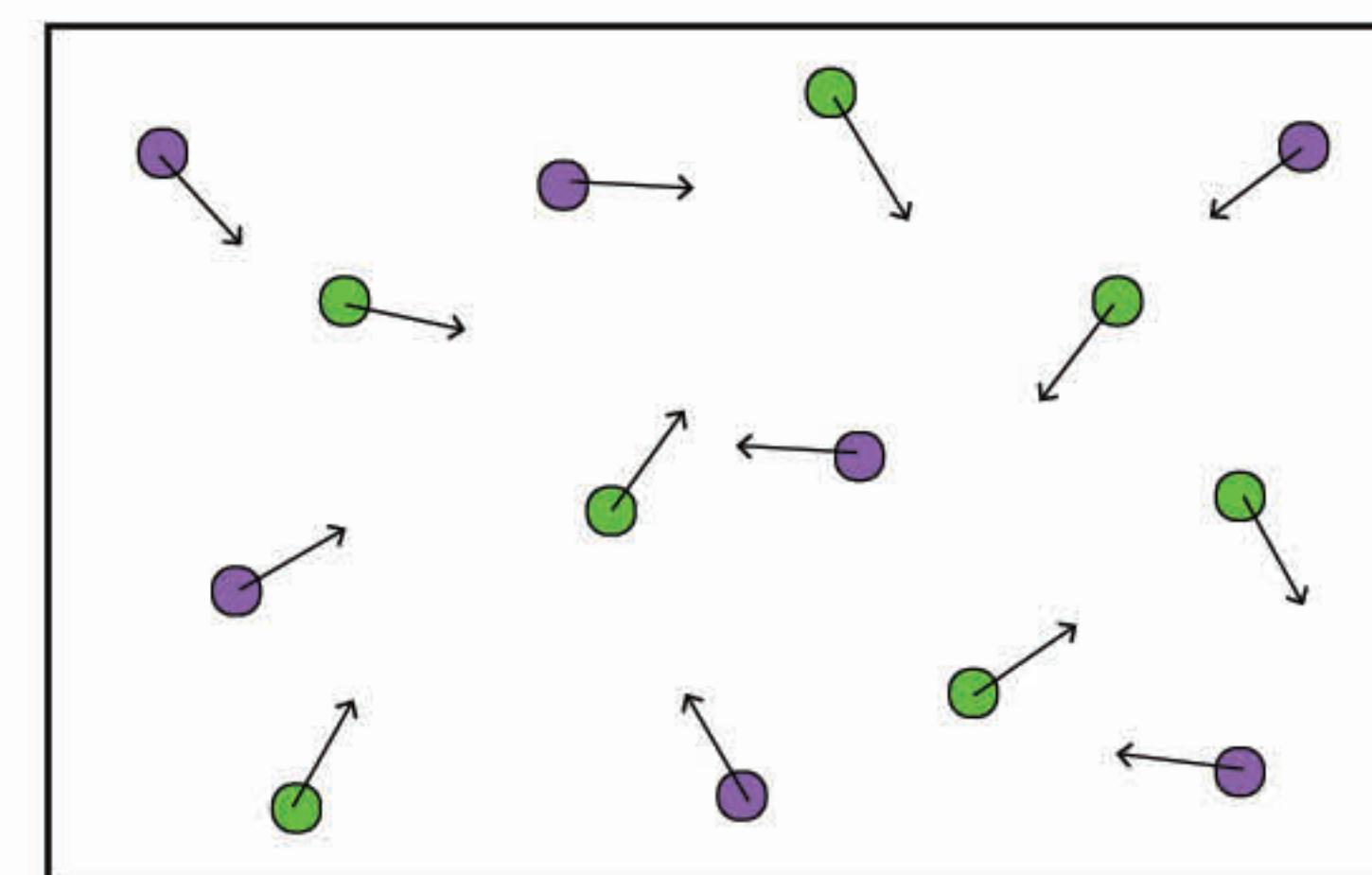
The speed of the chemical reaction increases.

3 The temperature of the reaction

★ On **increasing** the temperature of the reactants, the speed of the reactants molecules **increases**, so the number of probable collisions between them **increases**, so the speed of the chemical reaction **increases**.



Lower temperature



Higher temperature

★ The speed of the reactant molecules in case of hot water is **greater than** its speed in case of cold water which leads to **increasing** the number of probable collisions between molecules, so the speed of the chemical reaction **increases**.



GIVE REASON

1 The speed of a chemical reaction increases by raising the temperature.

Due to increase in the number of probable collisions between reactant molecules.

2 The fridge is used to preserve food.

Because the low temperature in the fridge slows down the speed of the chemical reactions done by bacteria which causes the rot of food.

3 If you want to cook food faster, you have to increase its temperature.

Because the speed of reactions of cooking food increases by increasing the temperature.

WHAT HAPPENS WHEN

1 Putting two effervescent tablets in two beakers, one of them contains cold water and the other contains hot water.

An effervescence occurs in case of hot water faster than in case of cold water.

2 Increasing the temperature of the reaction "related to the number of collisions".

The number of collisions between molecules increases.

4 Catalyst

A catalyst

It is a chemical substance which changes the rate of the chemical reaction without changing or being used up.

Types of catalytic reactions

1 Positive catalytic reactions

They are chemical reactions in which the catalyst increases their speed. Most catalysts speed up the chemical reaction (positive catalysts).

2 Negative catalytic reactions

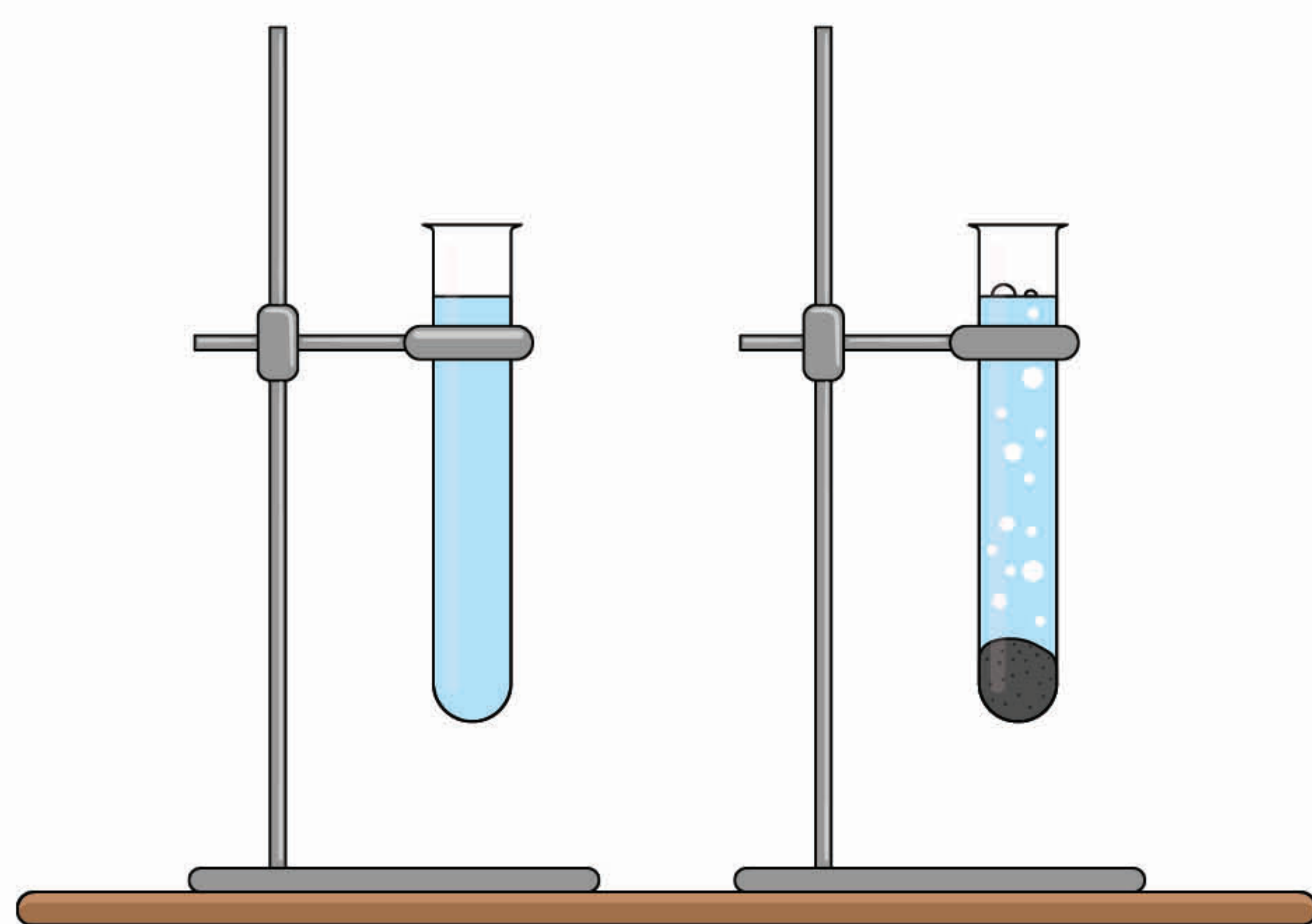
They are chemical reactions in which the catalyst decreases their speed.

Properties of catalysts

1. They change the speed of reaction but don't affect either its beginning or stopping.
2. They are used in a few amounts which are often enough to complete the reaction.
3. They are bonded to reactants during the reaction but get separated from them rapidly after formation of the resultants at the end of the reactions.
4. They decrease the energy needed for the reaction.
5. No chemical changes or a decrease in the mass occurs to the catalyst after ending the reaction.

★ Manganese dioxide acts as a **catalyst** that **increases** the speed of decomposition of hydrogen peroxide into water and oxygen gas which evolves as bubbles.

★ The speed of the chemical reactions **increases** by adding a catalyst.



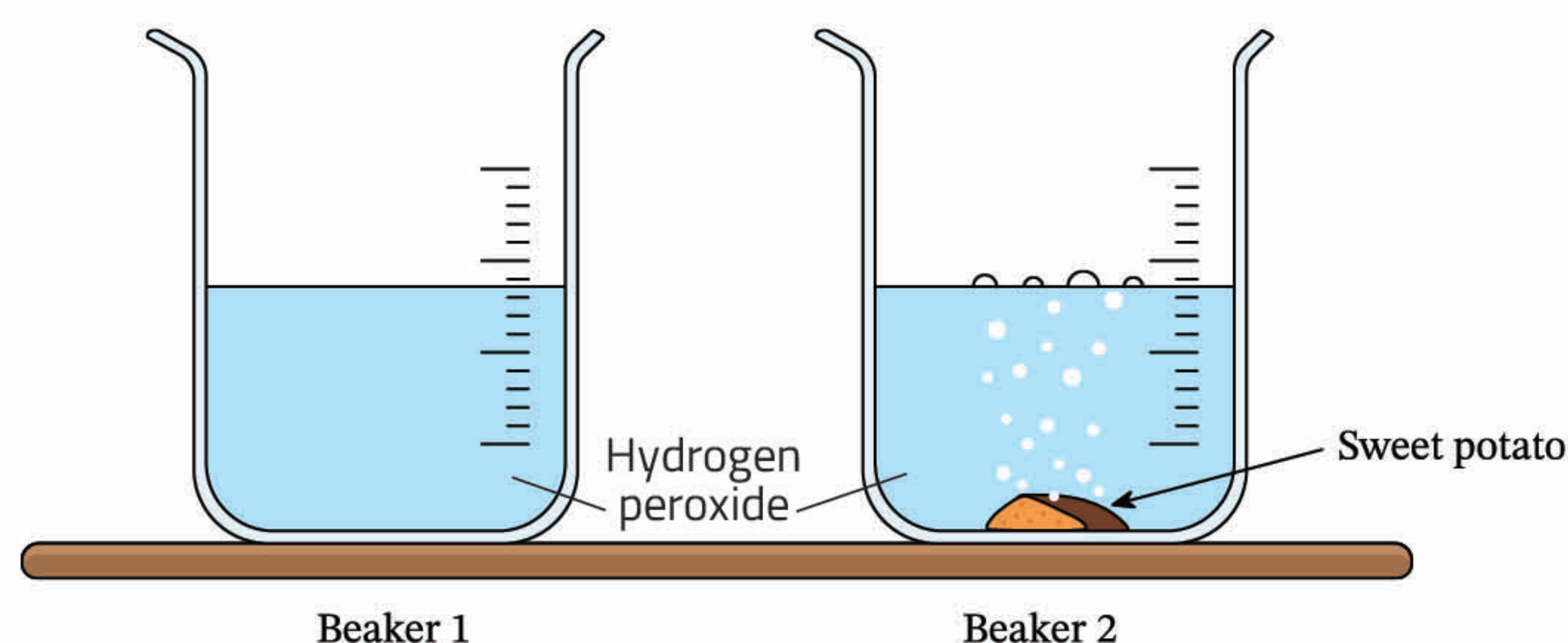
Enzymes

They are chemical substances produced by the body of a living organism, act as a catalyst that increase the speed of biological reactions.

- ★ The biological reactions that occur in the presence of enzymes are more rapid than that without the enzymes thousands or even millions times.
- ★ Each enzyme has a specific function, a molecule of one enzyme can do its function million times per minute.
- ★ Without enzymes, man can never breathe, move or even digest food.

★ On adding a piece of sweet potato to hydrogen peroxide, we notice **increasing** the number of the evolved bubbles.

★ **Oxidase enzyme** in sweet potato acts as a catalyst which increases the rate of decomposition of H_2O_2 into water and oxygen.



GIVE REASON

1 Catalyst is used in some chemical reactions.

To increase the rate of chemical reactions.

2 Adding a few manganese dioxide powder to hydrogen peroxide increases the number of evolved gas bubbles.

Because manganese dioxide acts as a catalyst which increases the speed of decomposition of hydrogen peroxide into water and oxygen gas.

3 Adding a piece of sweet potato increases the decomposition of hydrogen gas.

Because the oxidase enzyme in sweet potato acts as a catalyst which increases the rate of decomposition of hydrogen peroxide into water and oxygen gas.

WHAT HAPPENS WHEN

1 Adding a few MnO_2 powder to hydrogen peroxide.

Hydrogen peroxide decomposes (breaks up) rapidly into water and oxygen gas evolves.

2 Putting a piece of sweet potato in a flask containing hydrogen peroxide.

The rate of decomposition of hydrogen peroxide increases.

3 Adding a negative catalyst to a rapid reaction.

The speed of the reaction will be decreased.

Science, Technology and Society

Catalytic converter

Catalytic converter

It is a metallic can that exists in most modern cars to treat the harmful gases emitted from the engine.

Structure

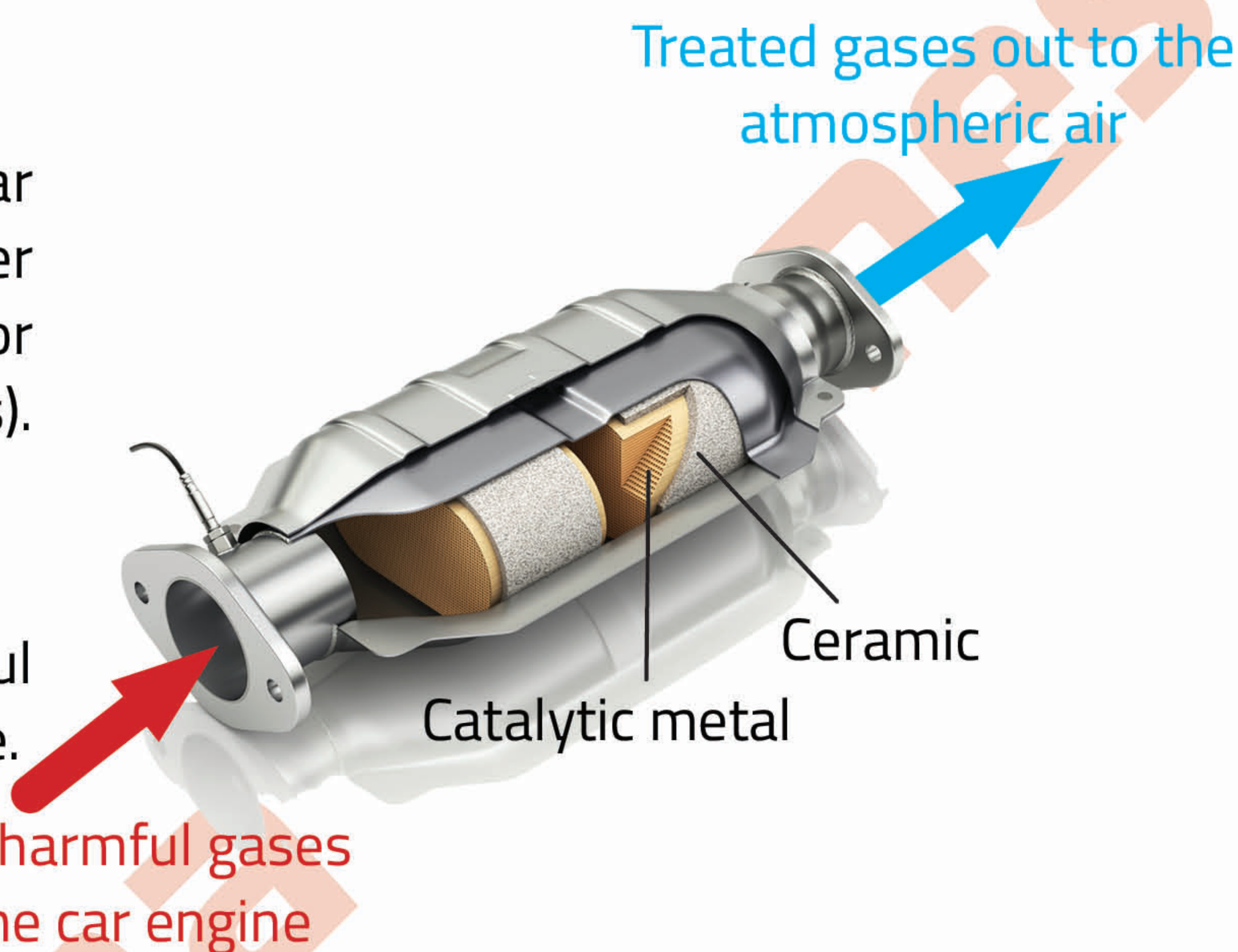
It is composed of ceramic cells (similar to bee cells) covered with thin layer of a catalytic metal as platinum, or palladium or iridium (expensive metals).

Importance

It helps in the treatment of harmful gases emitted from the car engine.

Idea of operation

- 1 Ceramic cells are similar to bee cells which increase the surface area of the catalytic substance exposed to the current of the emitted gases from the engine so as to economize the use of expensive metals.
- 2 The catalysts increase the speed of reactions of the treatment of the harmful gases emitted from the engine.



Usage of sodium bicarbonate in our life

A In the home:

- 1 **Put a small amount of sodium bicarbonate in the vacuum cleaner bag.** **GIVE REASON**
To get rid of the smell of dust that appears during cleaning.
- 2 **Put a small amount of sodium bicarbonate in the bottom of the waste basket before putting the bag.** **GIVE REASON**
To prevent the bad odours.
- 3 **Put a small amount of sodium bicarbonate in the kitchen's sink and pour on it boiling water.** **GIVE REASON**
To make the draining of the sink becomes faster.
- 4 **Soak the legumes in water and add a small amount of sodium bicarbonate.** **GIVE REASON**
To help in decreasing the bloating that accompanies eating of legumes.

B In polishing metals:

- 1 ▶ Put the silver tools in a bowl covered with aluminum foil,
▶ then cover them with boiling water added to it sodium bicarbonate,
▶ then dried them after rinsing with water to return to its luster.
- 2 Rub any decorative metal pieces made of copper or chrome with a piece of cloth wet with water and immersed in sodium bicarbonate.

C In the garden:

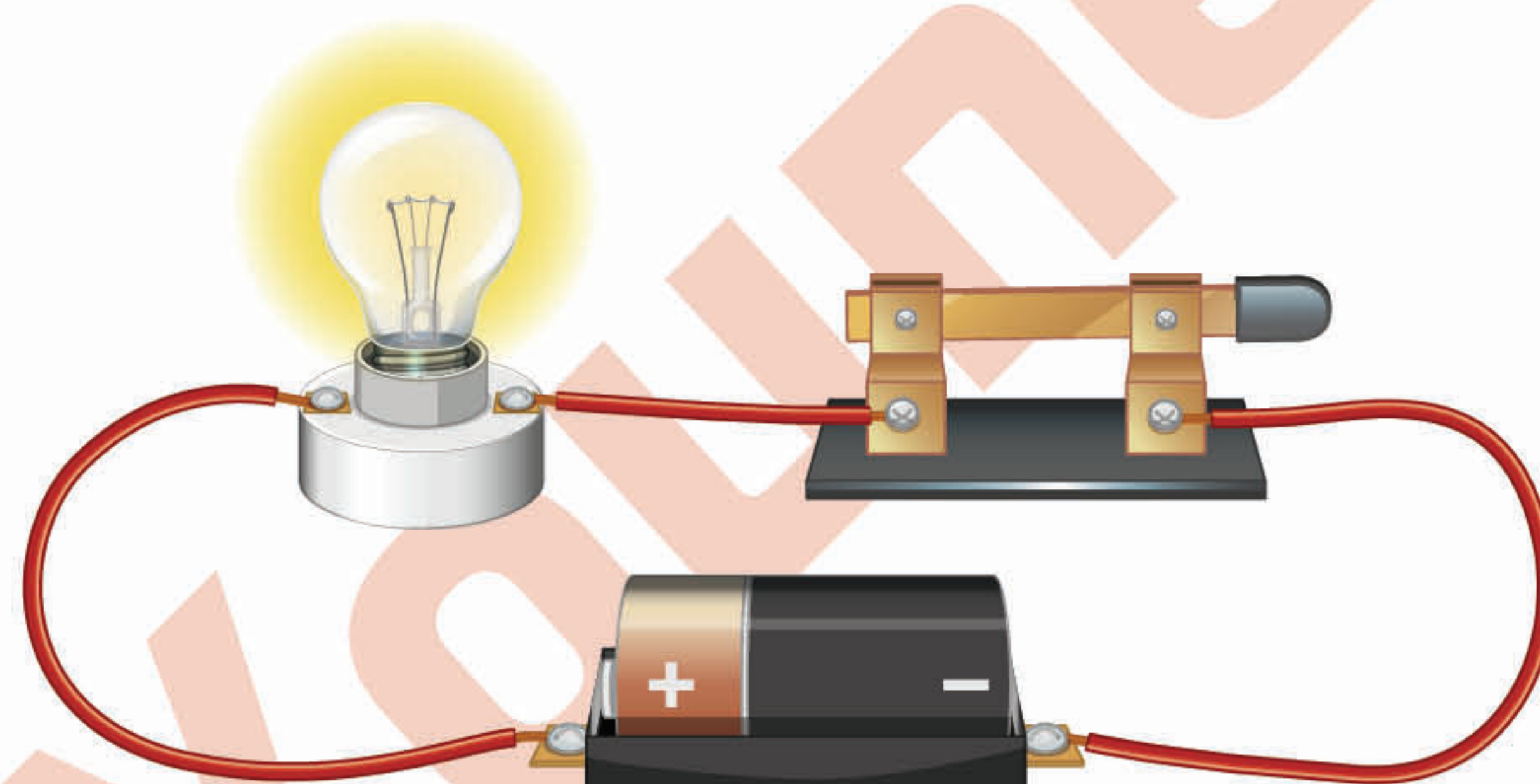
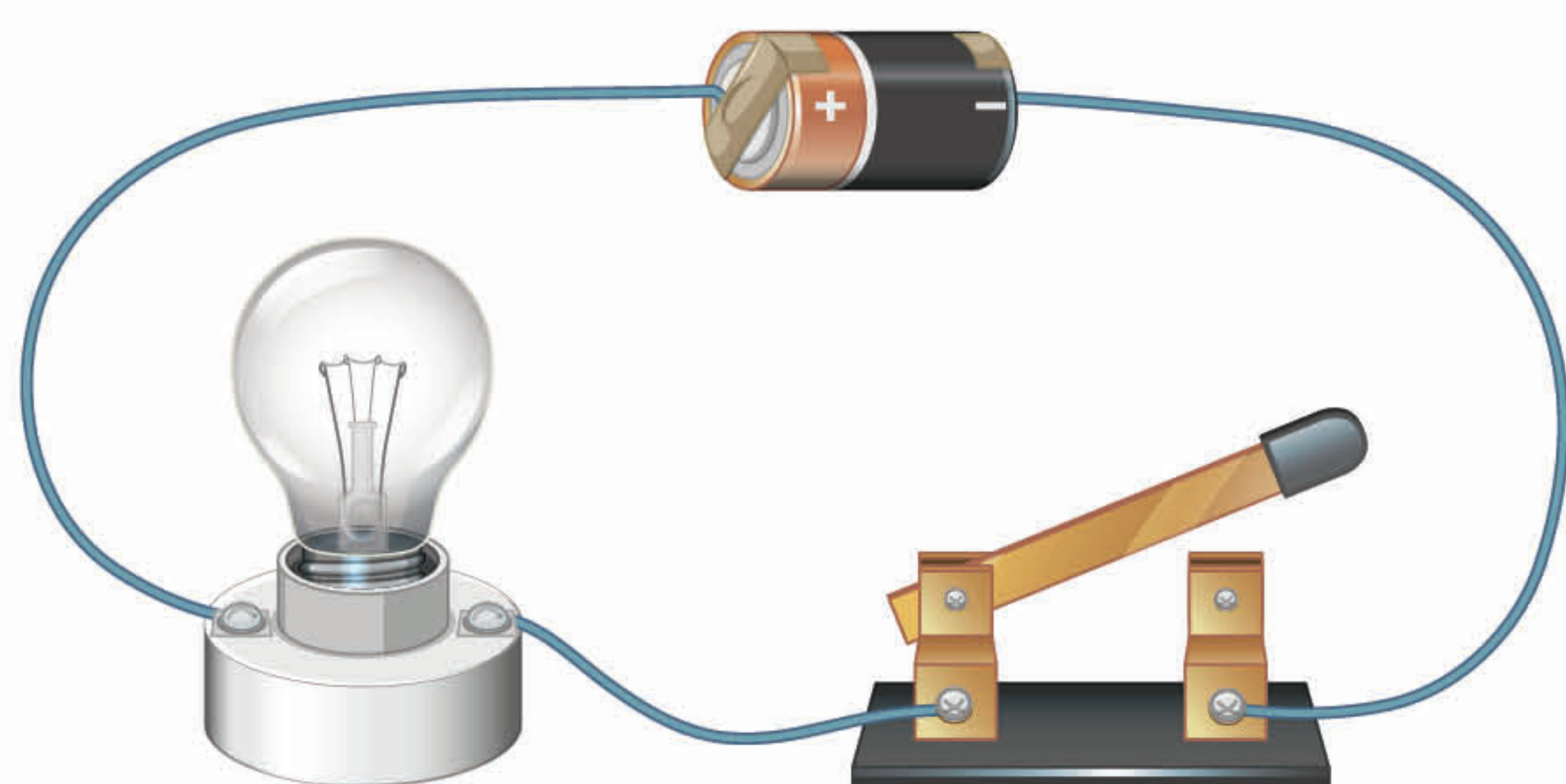
Put sodium bicarbonate (without any additives) in the places where ants come out, and by passing time you notice their disappearance.

Physical properties of electric current

★ Importance of electricity in our life:

- 1 It is used to light up our houses, factories, streets, ... etc.
 - 2 It is used in operating some machines, such as radios, televisions, washing machines, irons, electric heaters, ... etc.
- ★ The electric energy is the cleanest source of energy as it does not pollute the environment.

Electric circuit



Components	Role (function)	Shape	Symbol
Electric lamp	It indicates the flow of electric current.		
Electric key	Opening and closing the circuit		
Connecting wire	Connecting the components of the electric circuit with each other.		
Dry cell	The source of the electric current		
Battery			

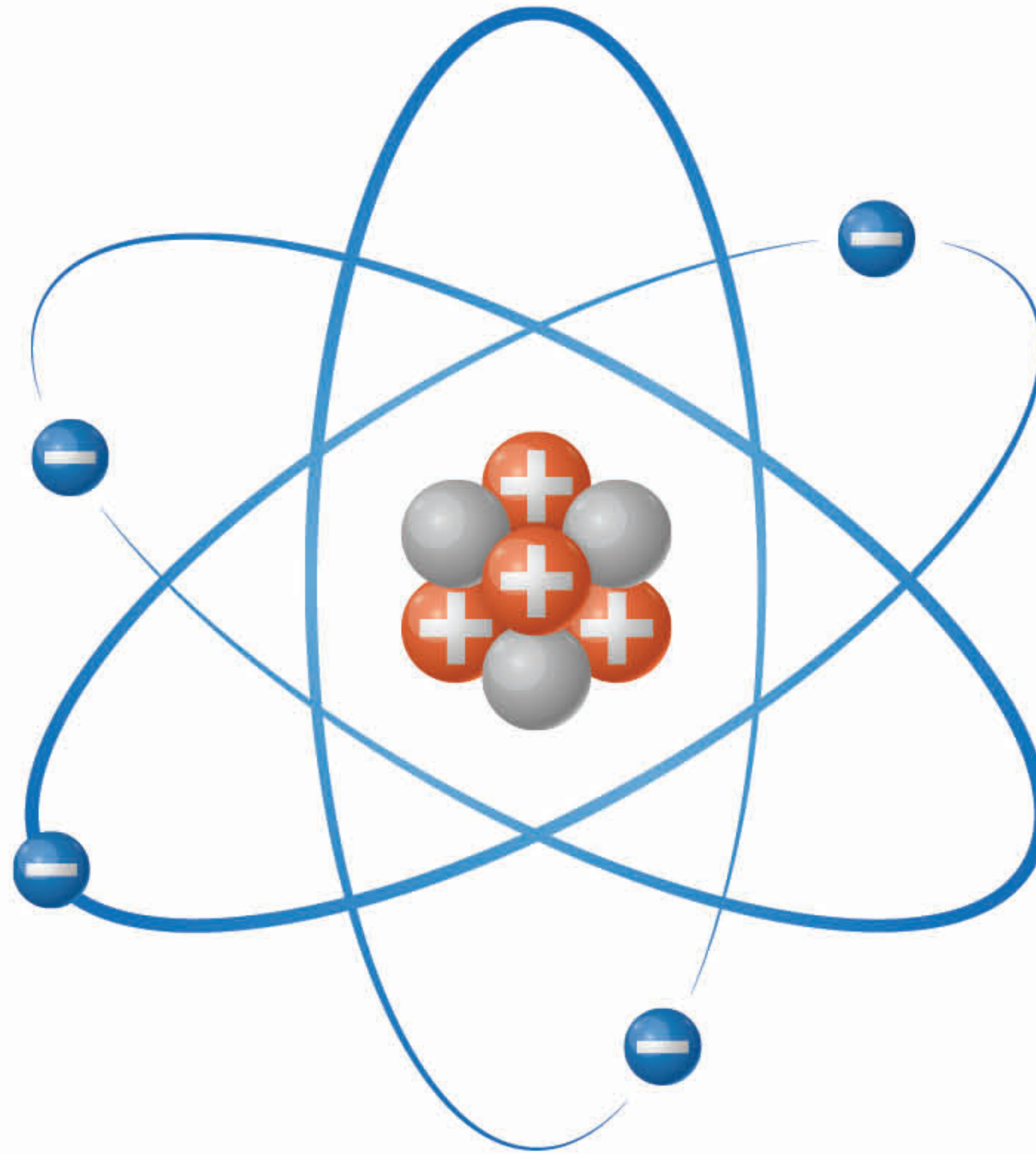
Electric current

Electrons

Negatively charged 

They are very small particles which rotate around nucleus. GIVE REASON

Due to the attraction force between the nucleus and electrons.



Nucleus

Positively charged

It is found in the center of the atom and contains:

- Protons : +ve charge.
- Neutrons : neutral.

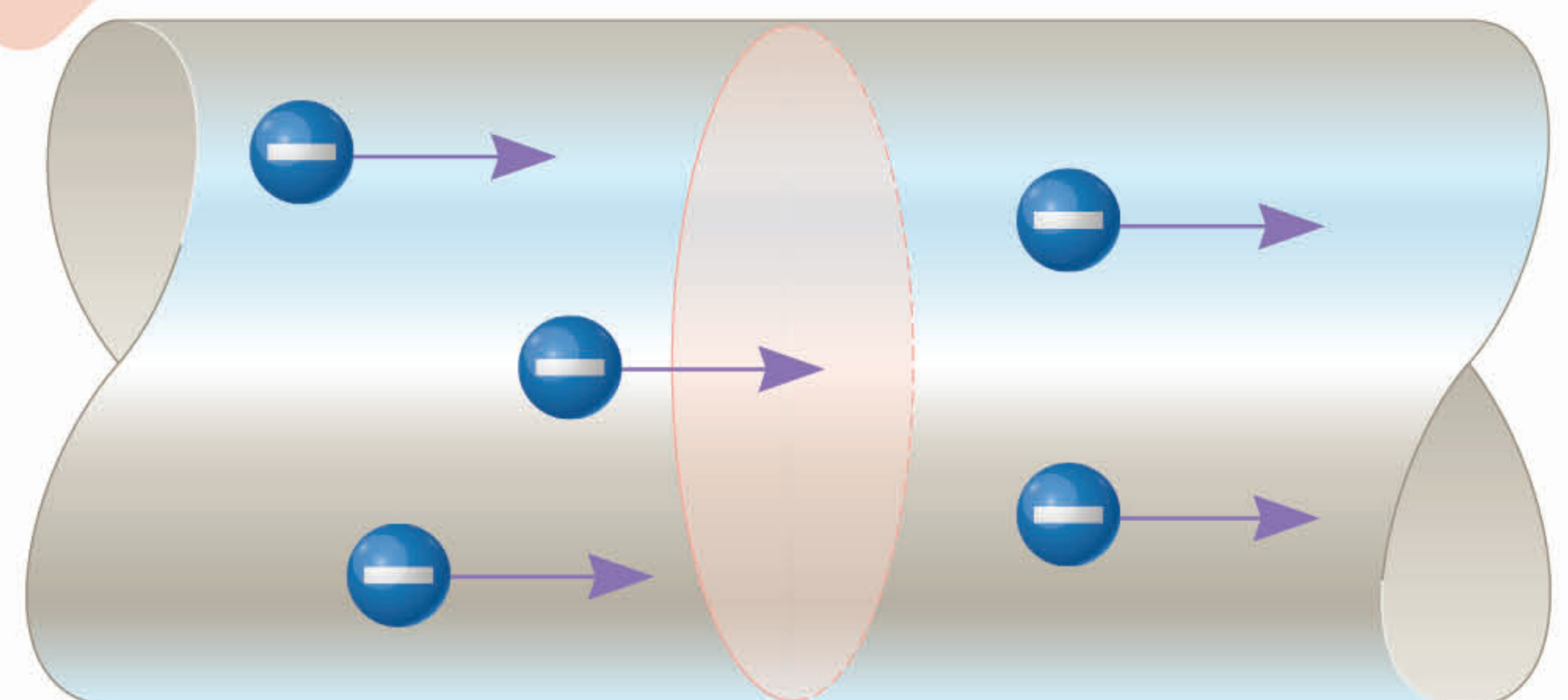
GIVE REASON

- 1 Electrical conducting wires are made up of metals characterized by the presence of weak attraction force between its protons and its electrons.**

Because on connecting these wires with an electric source, an electromotive force is generated and electrons are pumped in one direction and move in the wires (conductors) creating the electric current.

The electric current

It is the flow of electric negative charges (electrons) through a conducting material.



GIVE REASON

- 1 The electric energy is the cleanest source of energy.**

Because it does not pollute the environment.

- 2 The atom is electrically neutral.**

Because the number of protons in the nucleus equals the number of electrons that rotate around it.

- 3 The nucleus is positively charged.**

Because it contains protons (positively charge) and neutral neutrons.

- 4 The electrons still rotate around the nucleus.**

Due to the attraction force between the protons in the nucleus and electrons.

5 The electrons may leave the atom and move freely.

Due to the weakness of the attraction force between the protons and electrons.

6 The current flows through the circuit only when it is closed.

Because when the circuit is closed, all its components are connected.

WHAT HAPPENS WHEN

1 Vanishing or decreasing the attraction force in the atom between the nucleus and the electrons in the outer level.

The electrons in the outer level become free.

Physical properties of the electric current

Current intensity

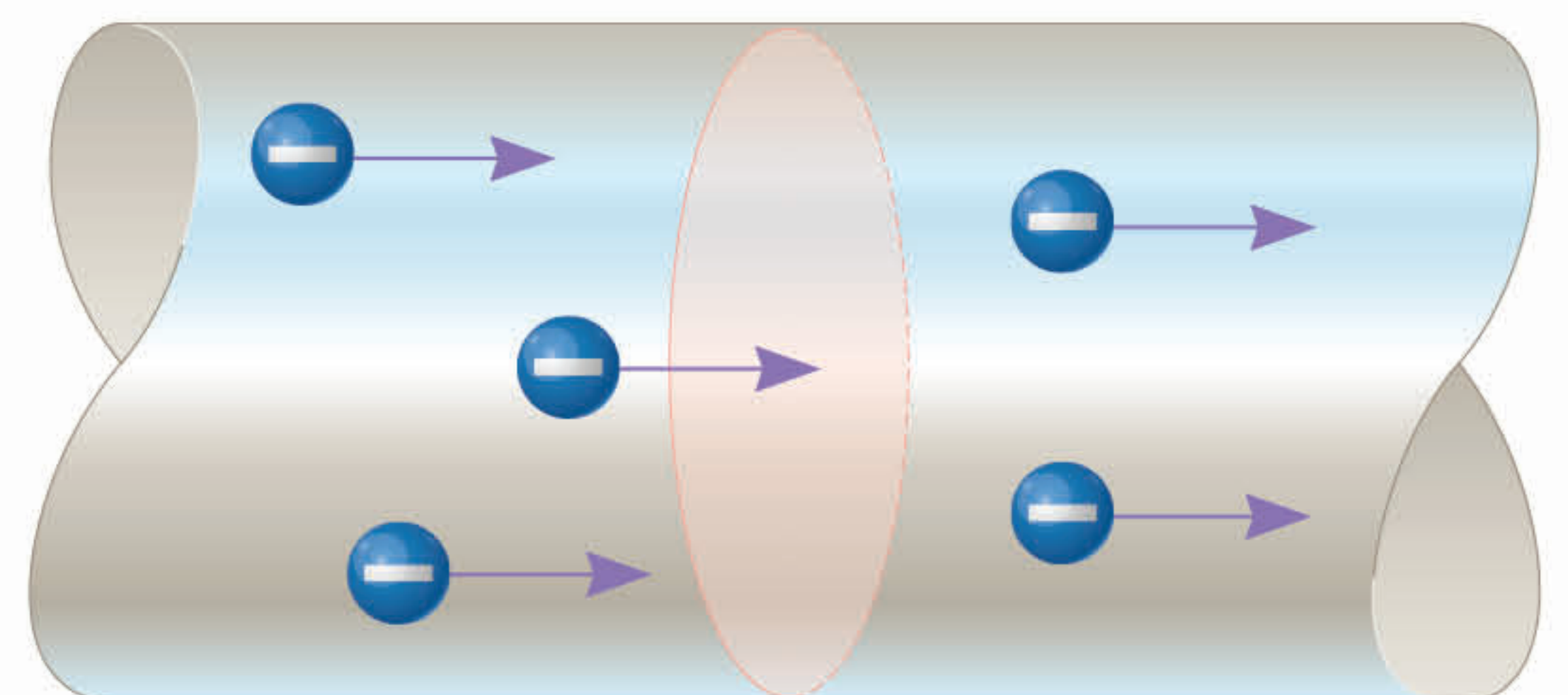
Potential difference

Electric resistance

Current intensity

Electric current intensity

It is the quantity of electricity in coulomb or the electric charges flowing through a cross-section of the conductor in one second.



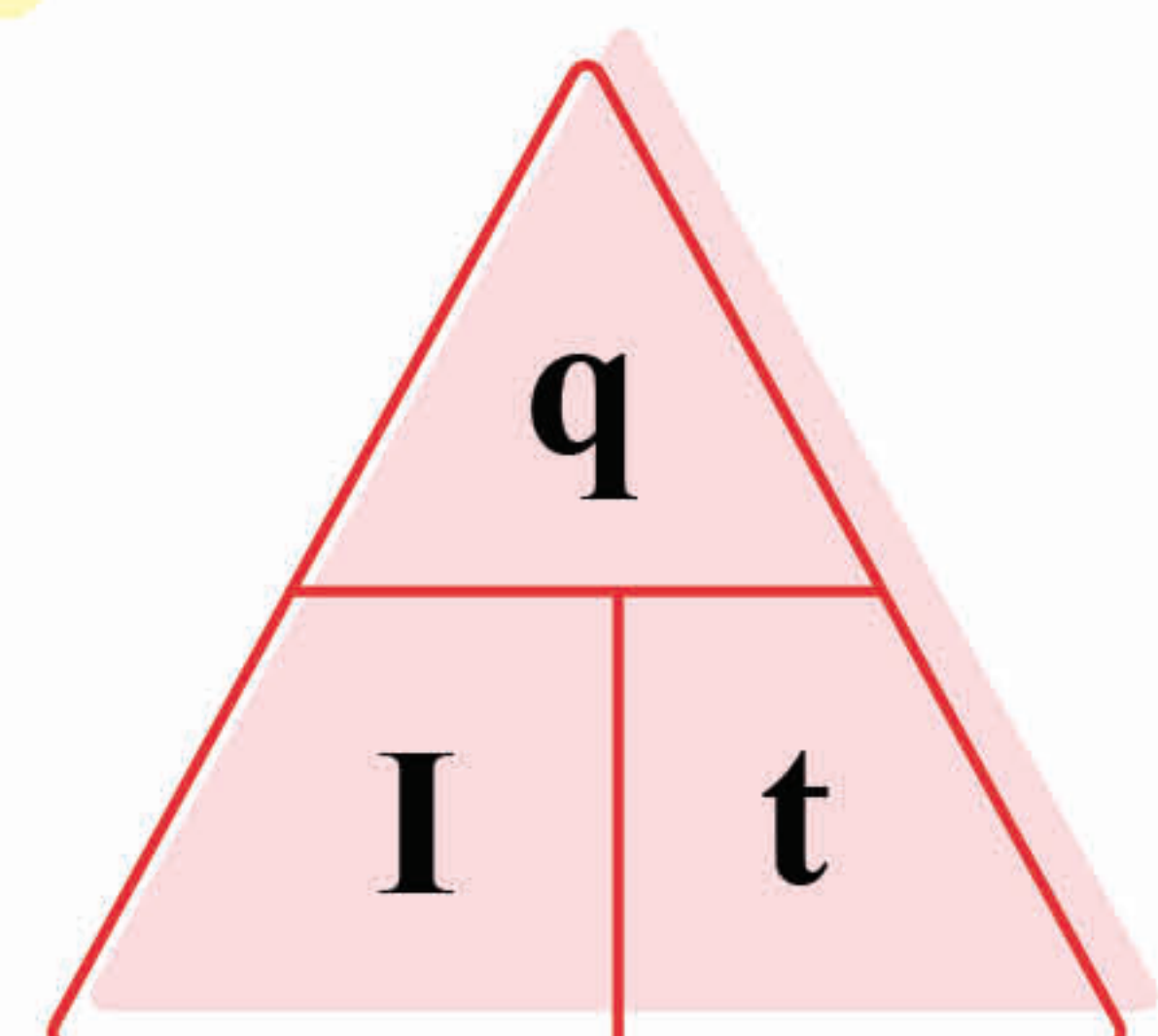
$$\text{Current intensity (I)} = \frac{\text{Quantity of charge (q)}}{\text{Time in seconds (t)}}$$

Measuring unit

Current intensity (I) is Ampere

Quantity of charge (q) is Coulomb

Time (t) is Second



The ampere

It is the electric current intensity passing through a circuit when a quantity of charge of one coulomb passes through a given cross-section in time of one second.

The coulomb

It is the quantity of charge transferred by a constant current of intensity of one ampere in time of one second.

- ★ **Electric current intensity (I)** is **directly** proportional to the **quantity of charge (q)**, when the **time (t)** is constant.
- ★ **Electric current intensity (I)** is **inversely** proportional to the **time of charge flowing (t)**, when the **quantity of charge (q)** is constant.

WHAT HAPPENS WHEN

- 1 A quantity of charges that passes through a cross-section of a conductor in one second increases.**
The electric current intensity increases.
- 2 The time of flowing the electric charges through a certain cross-section of a conductor is doubled.**
The electric current intensity decreases to its half.
- 3 The quantity of charge flowing through a conductor increases to the double, and the time remains constant.**
The electric current intensity increases to double.
- 4 The quantity of charge flowing through a conductor increases to the double, and the time decreases to half.**
The electric current intensity increases to four times.

The ammeter apparatus

Uses

It is used in measuring the electric current intensity passing through the circuit.

Symbol

It is given the symbol  in the electric circuit.

Connection

It is connected in the electric circuits in **series**, as follows:

- ☐ The positive pole of the ammeter (**red pole**) is connected to the positive pole of the dry cell.
- ☐ The negative pole of the ammeter (**black pole**) is connected to the negative pole of the dry cell.

Note

Ammeter is not connected directly to the battery, because this damages the ammeter.



GIVE
REASON

- 1 In the electric circuit, the ammeter is connected in series.**

To measure the electric current intensity passing through the circuit.

SOLVED PROBLEMS

- 1 Calculate the current intensity passing through a cross-section due to the flow of 5400 coulomb of charge for 5 minutes.**

Sol

$$t = 5 \times 60 = 300 \text{ s}$$

$$I = \frac{q}{t} = \frac{5400}{300} = 18 \text{ ampere}$$

- 2 If a quantity of electricity of 12 coulomb passes through a cross-section of a conductor in 3 second, what is the intensity of the current passing through that conductor?**

Sol

- 3 If an electric current of intensity 6 ampere passes through a conductor in 15 seconds, find the quantity of electric charge through a cross-sectional area of this conductor.**

Sol

$$q = I \times t = 6 \times 15 = 90 \text{ coulomb}$$

- 4 Calculate the quantity of electricity that flows in a wire when an electric current of intensity 18 ampere passes for 7 minutes through this wire (conductor).**

Sol

- 5 Calculate the time needed to pass a charge of 25 coulomb through a wire if the current intensity which passes through it is 5 ampere.**

Sol

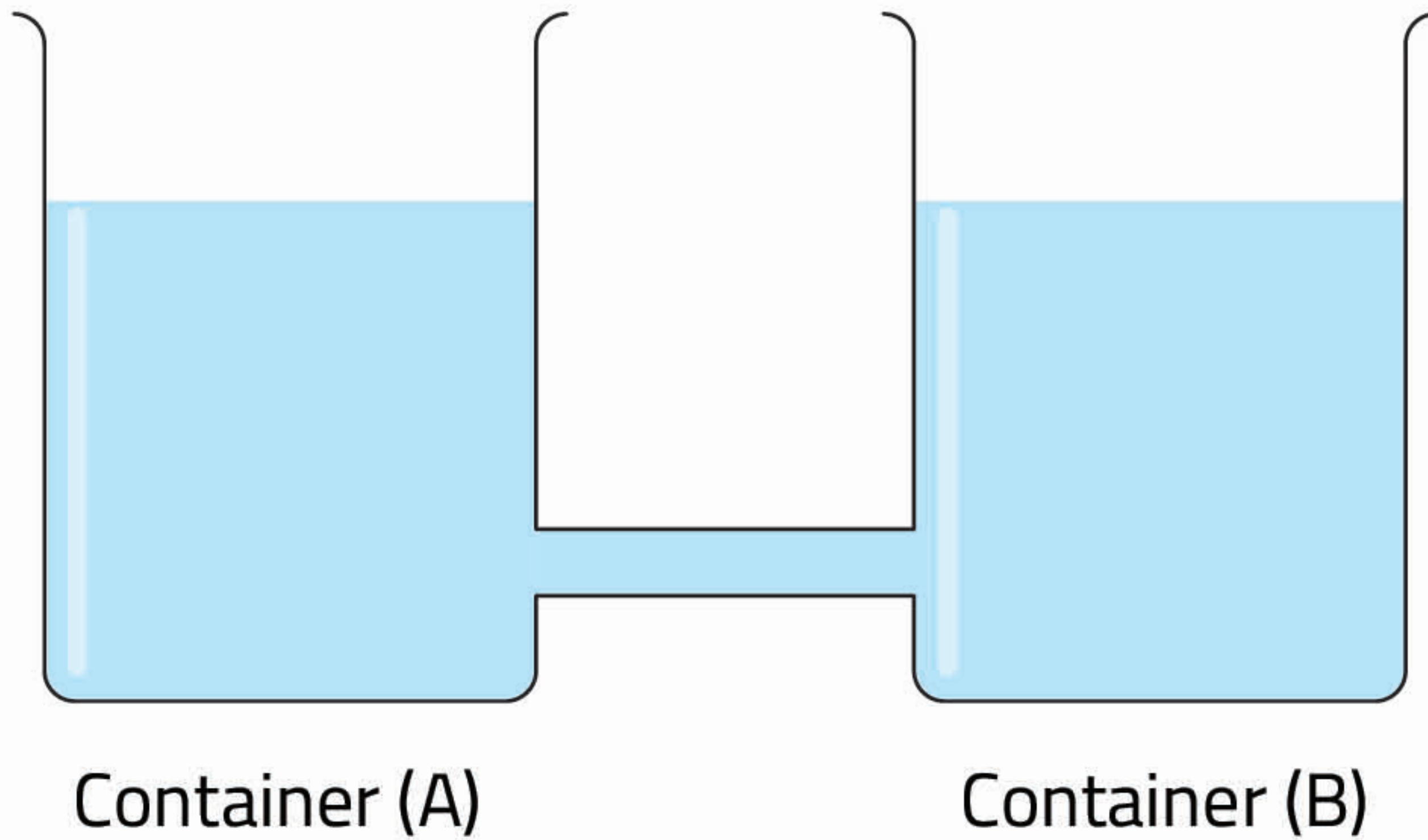
$$t = \frac{q}{I} = \frac{25}{5} = 5 \text{ second}$$

- 6 A charge of 250 coulomb passes through a metal conductor. The current is then found to be 10 ampere. Calculate the time needed to pass this charge.**

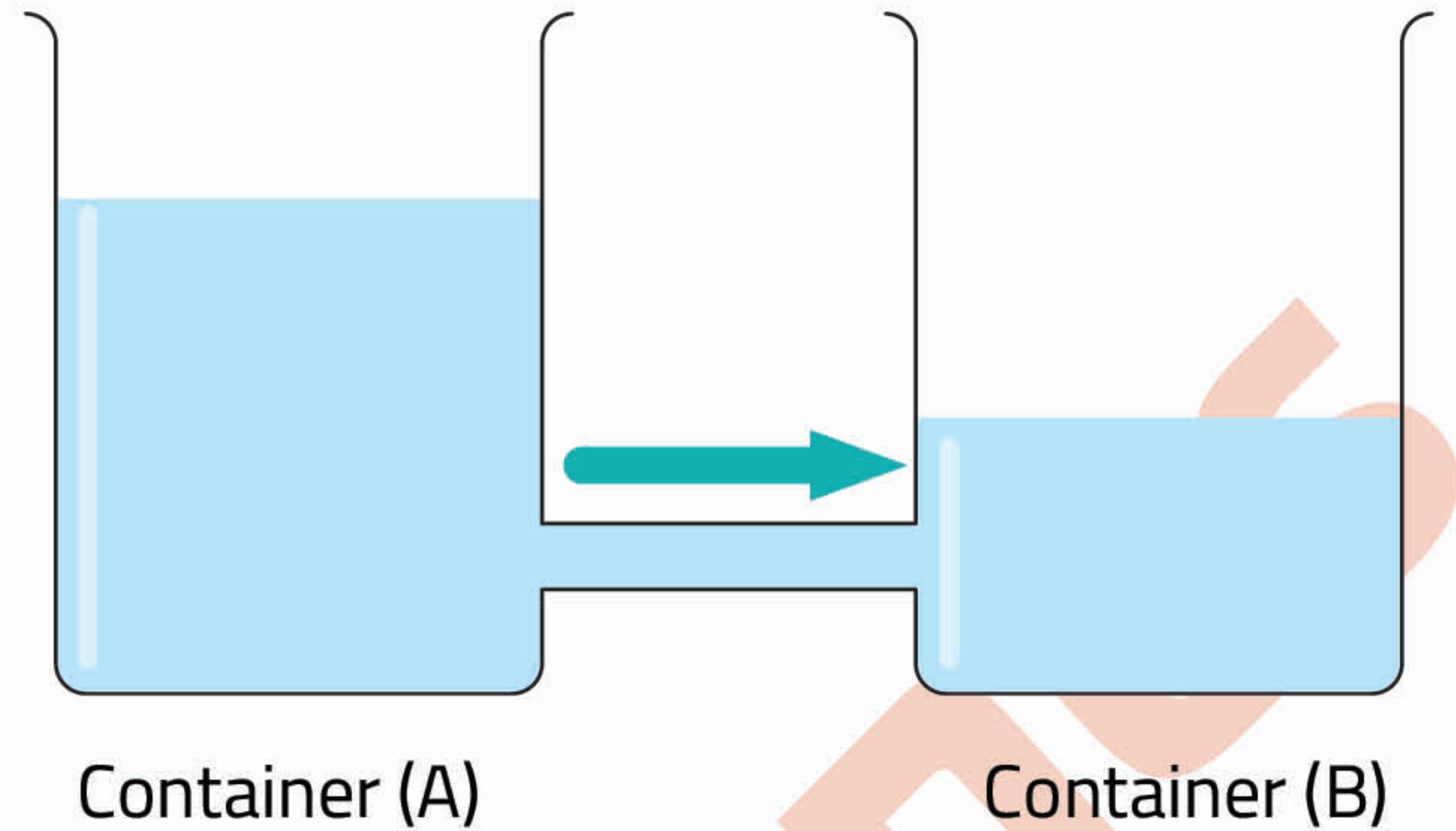
Sol

Potential difference

Water transfer

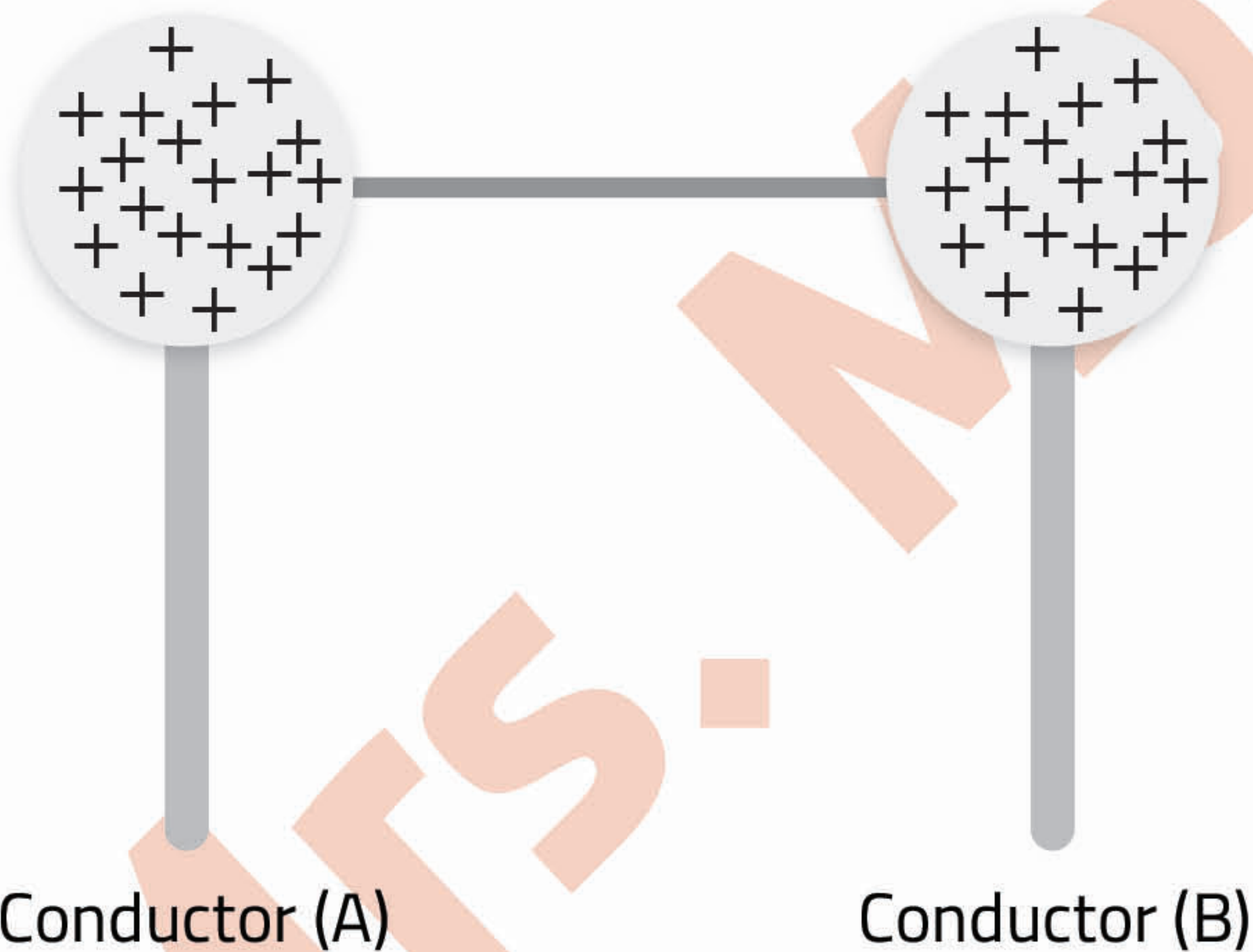


- ★ Water in container (A) is at the same height (**same potential**) as water in container (B).
- ★ There is no height difference (**potential difference**) between containers (A) and (B).
- ★ There is no water flow (no matter how much water exists in the two containers).

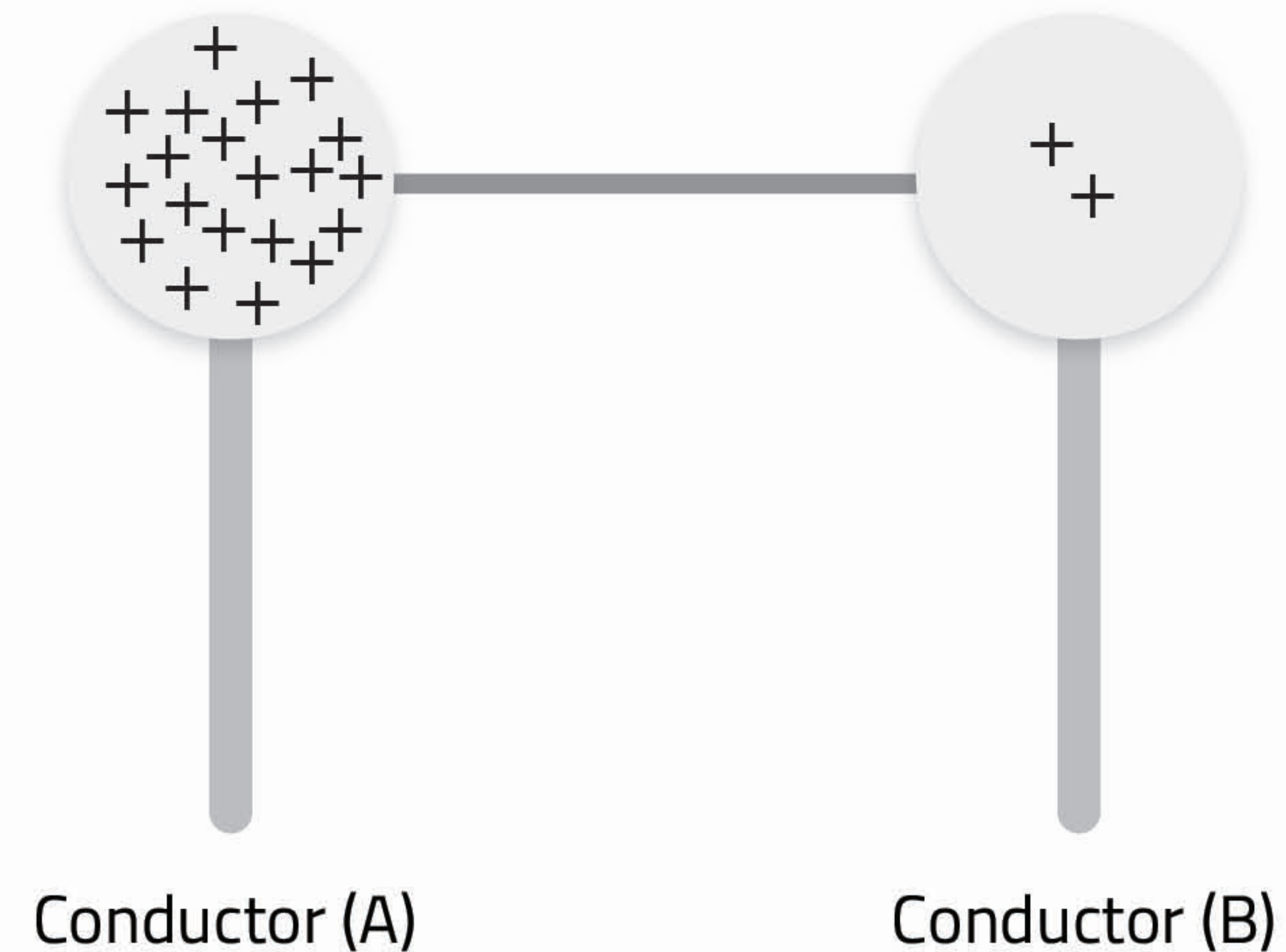


- ★ Water in container (A) is at height (**higher potential**) than water in container (B).
- ★ There is a height difference (**potential difference**) between containers (A) and (B).
- ★ Water flow from container (A) (**higher potential**) to container (B) (**lower potential**).

Electric charges transfer



- ★ Quantity of charge in conductor (A) is the same (**same potential**) as quantity of charge in conductor (B).
- ★ There is no **potential difference** between conductors (A) and (B).
- ★ There is no charge flow (no matter how much charge exists in the two conductors).



- ★ Quantity of charge in conductor (A) is more than (**higher potential**) than quantity of charge in conductor (B).
- ★ There is a **potential difference** between conductors (A) and (B).
- ★ Charge flows from conductor (A) (**higher potential**) to conductor (B) (**lower potential**).

- ★ The transfer of charges does not depend on their amount, but it depends on the difference in their potential.

يعني مهما كان فيه charge ما بين two points, طول ما مفيش potential difference
ما بينهم مش هيتنقل charges يعني مش هيمشي current.

Electric potential difference

It is the state of an electric conductor that shows the transfer of electricity from or to it when it is connected to another conductor.

- ★ If you want to move a quantity of water (weight = w) from a lower height to a higher level of height (h), the work required increases by increasing the weight of water and also by increasing height. This can be shown by the following relation:

$$\text{Work (W)} = \text{Weight} \times \text{height}$$

- ★ Similarly, in electricity, if you want to move a quantity of charge (q) across a potential difference (V), the work required increases by increasing the charge (q) and the potential difference (V) between the two points:

$$\text{Work (W)} = \text{Quantity of charge (q)} \times \text{Potential difference (V)}$$

$$\text{Potential difference (V)} = \frac{\text{Work (W)}}{\text{Quantity of charge (q)}}$$



Electric potential difference across two terminals of a conductor

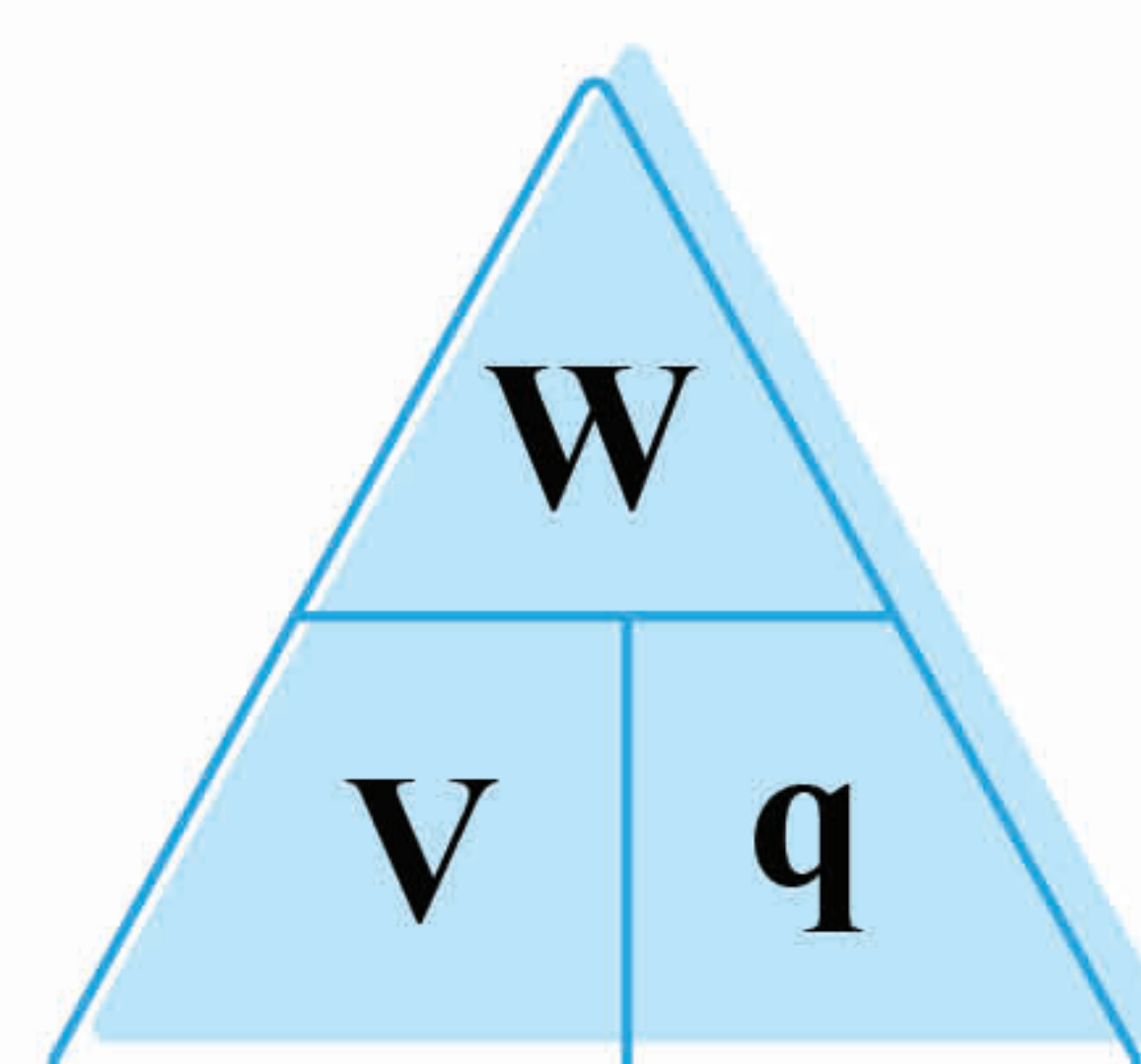
It is the value of the work done to transfer a quantity of charge (one coulomb) between the two poles of a conductor.

Measuring unit

Potential difference (V) is Ampere

Quantity of charge (q) is Coulomb

Work (W) is Joule



The volt

It is the potential difference across two terminals of a conductor on doing a work of one joule to transfer a quantity of charge of one coulomb.

The joule

It is the work done to transfer a quantity of charge of one coulomb between two terminal of a conductor at a potential difference of one volt.

- ★ **Electric potential difference (V)** is **directly** proportional to the **work done (W)**, when the **charge (q)** is constant.
- ★ **Electric potential difference (V)** is **inversely** proportional to the **quantity of charge (q)**, when the **work done (W)** is constant.

WHAT HAPPENS WHEN

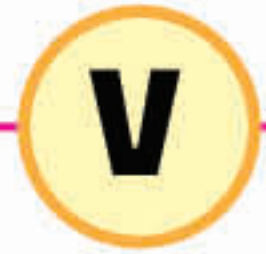
- 1 The work done through a conductor decreases to half and the quantity of charge remains constant.**
The potential difference decreases to half.
- 2 The quantity of charge flowing through a conductor decreases to half and the work remains constant.**
The potential difference increases to double.
- 3 The work done through a conductor increases to double and the quantity of charge decreases to half.**
The potential difference increases four times.
- 4 The work done through a conductor increases to double and the quantity of charge remains constant.**
The potential difference increases to double.

The voltmeter apparatus

Uses

It is used in measuring the potential difference between two ends of the conductor and the electromotive force of a battery.

Symbol

It is given the symbol  in the electric circuit.

Connection

It is connected in the electric circuits in **parallel**, as follows:

- ☐ The positive pole of the ammeter (**red pole**) is connected to the positive pole of the dry cell.
- ☐ The negative pole of the ammeter (**black pole**) is connected to the negative pole of the dry cell.



SOLVED PROBLEMS

- 1 If the work done to transfer an electric charge of 2 coulomb between two points is 240 joule, calculate the potential difference across the two points.

Sol

$$V = \frac{W}{q} = \frac{240}{2} = 120 \text{ V}$$

- 2 A 480-Joule of work is required to move a 2-coulomb charge between points (A) and (B). What is the potential difference between these two points.

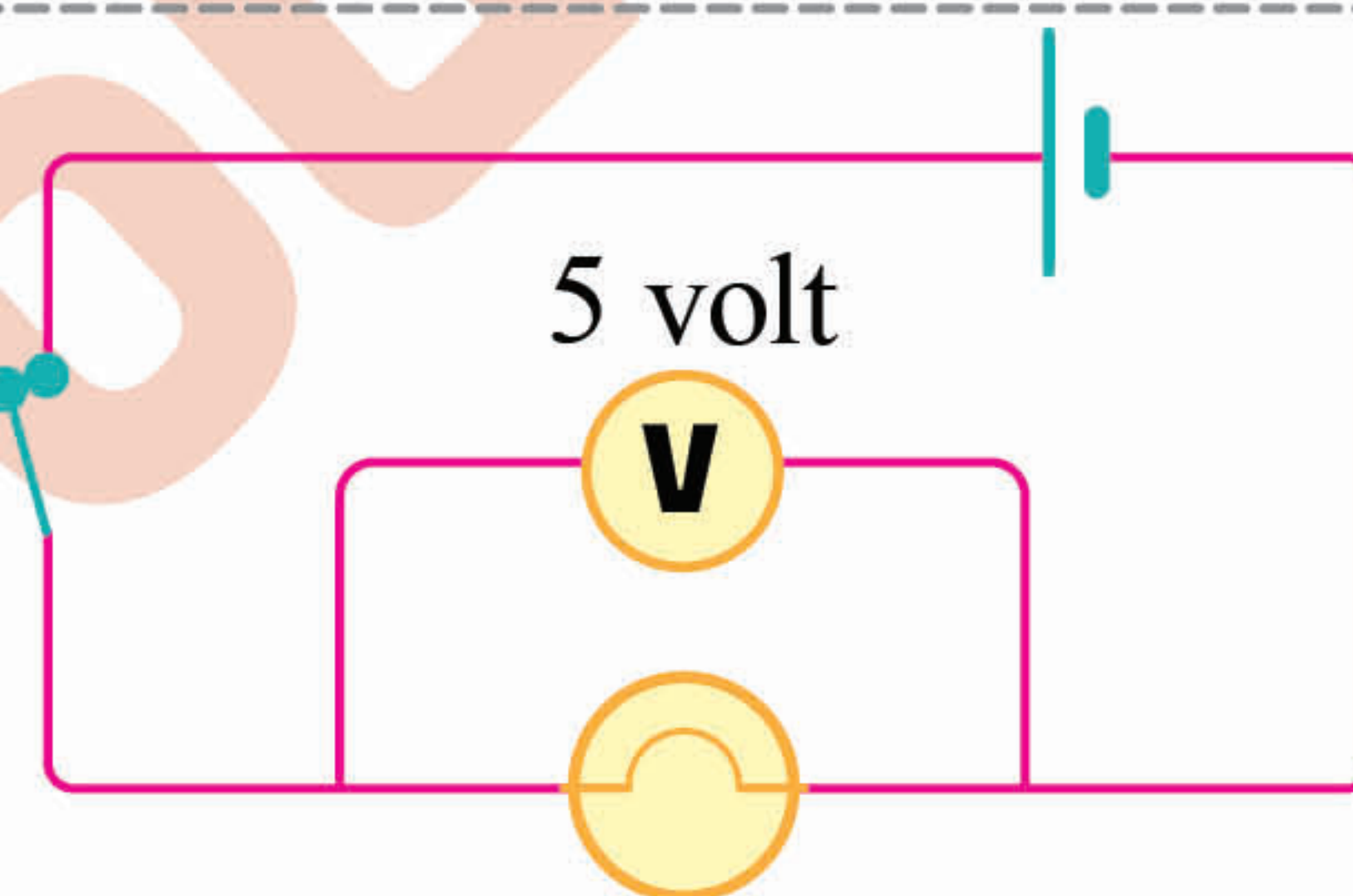
Sol

- 3 If the work done to transfer an electric charge between two points is 20 joule, and the time of charge flowing through the conductor is 2 second, calculate the electric current intensity passing through the circuit.

Sol

$$q = \frac{W}{V} = \frac{20}{5} = 4 \text{ coulomb}$$

$$I = \frac{q}{t} = \frac{4}{2} = 2 \text{ ampere}$$



- 4 Calculate the potential difference across two points when a work of 12 joule is done to transfer an electric charge of 3 coulomb between them. If this happened in half a minute, calculate the electric current intensity flowing through the two points.

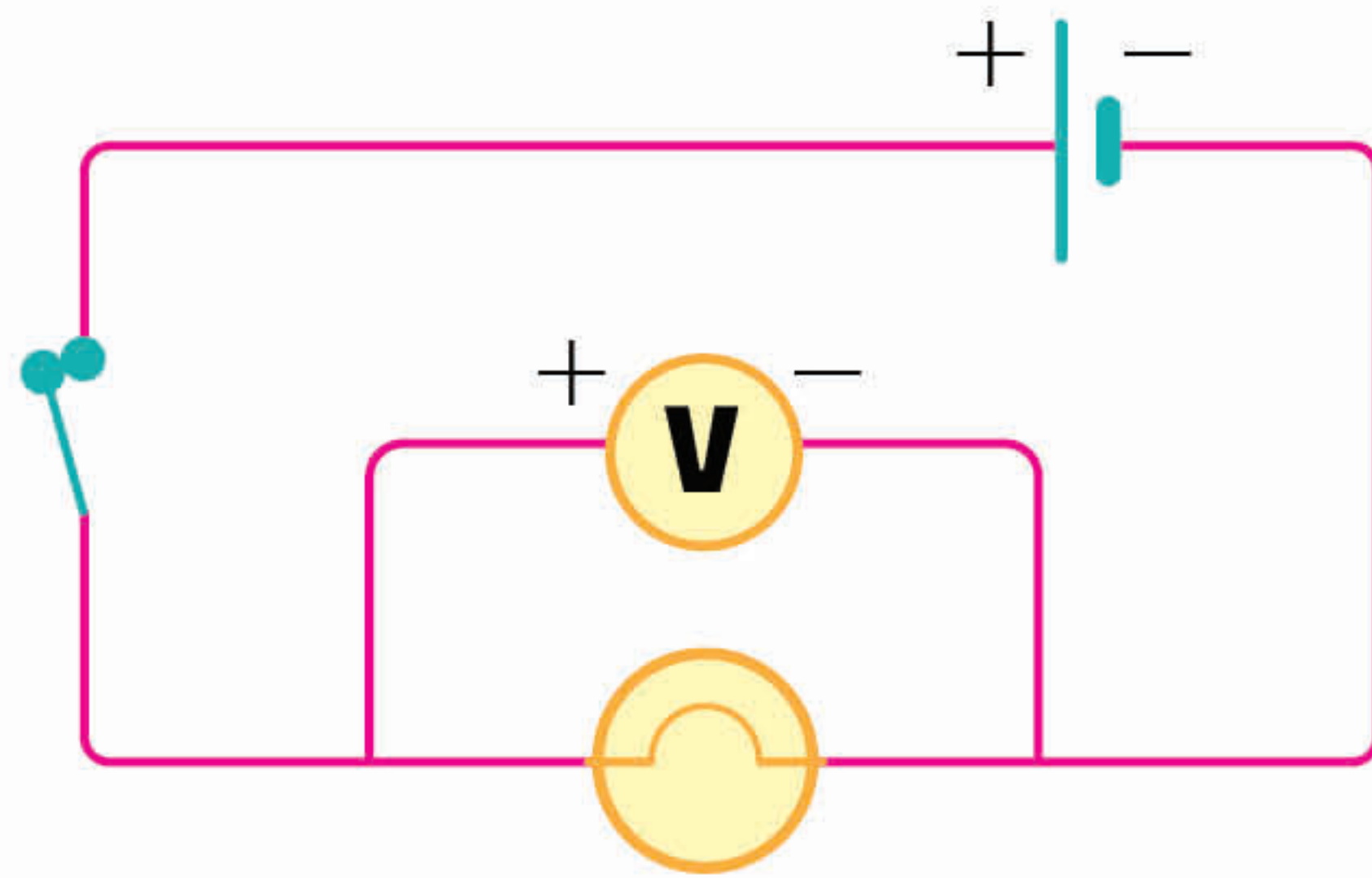
Sol

- 5 If the work done to transfer a quantity of charge through a conductor equals 150 joule and potential difference across its terminals is 3 volt, calculate the electric current intensity which passes in time equals 10 seconds in this conductor.

Sol

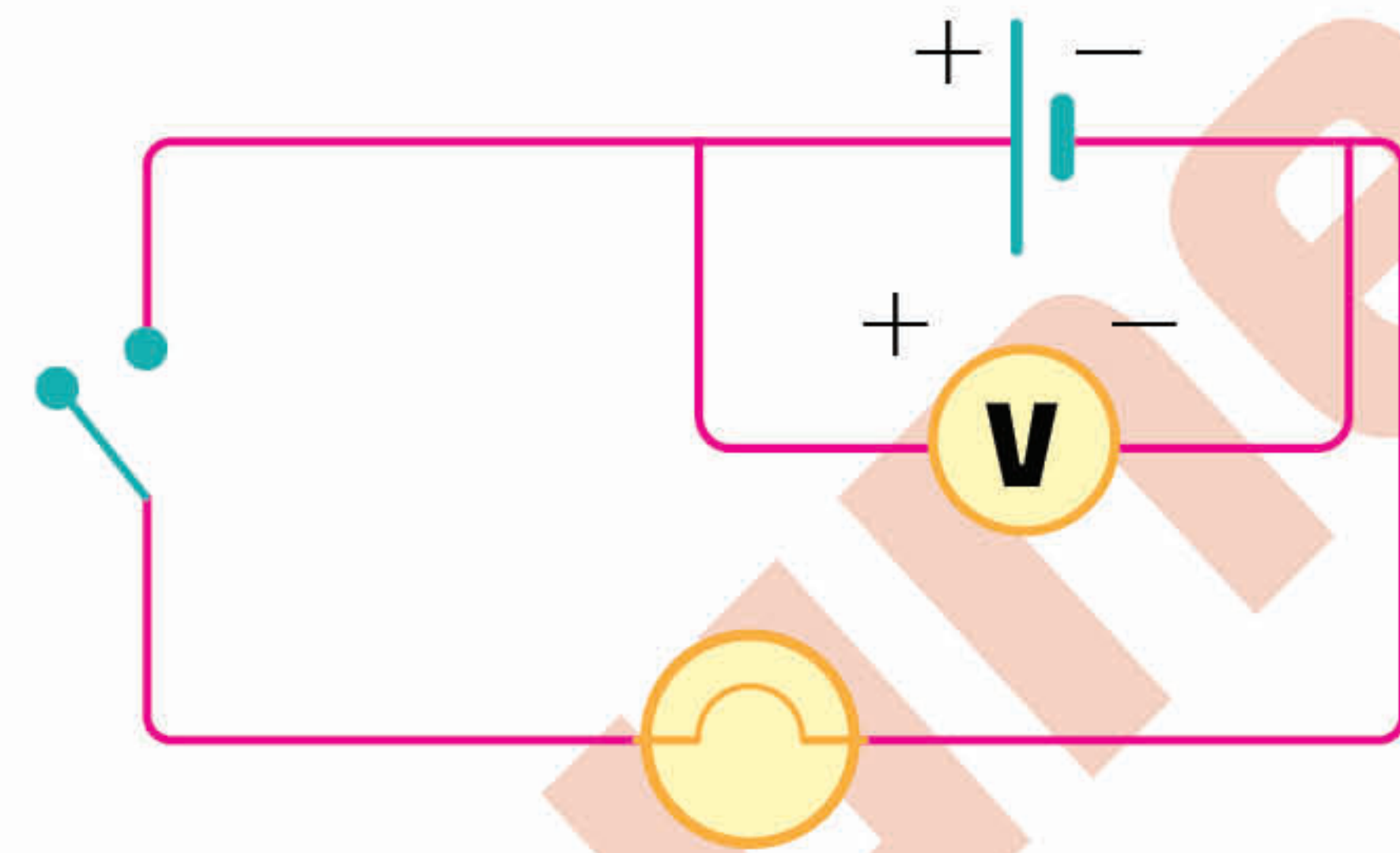
Potential difference between the two ends of a conductor

- It is connected **in parallel** between the two ends (terminals) of the conductor to measure the **potential difference**.
- The circuit is **closed**.



Potential difference between the two ends of a battery

- It is connected **in parallel** between the poles of the dry cell or battery to measure the **electromotive force (e.m.f) of the battery**.
- The circuit is **open**.



P.O.C	Voltmeter	Ammeter
Symbol		
Uses	a. measuring the the potential difference between two points in an electric circuit. b. measuring the e.m.f. of an electric source.	The current intensity in an electric circuit.
Connection	Parallel connection	Series connection
Measuring unit	Volt	Ampere

GIVE REASON

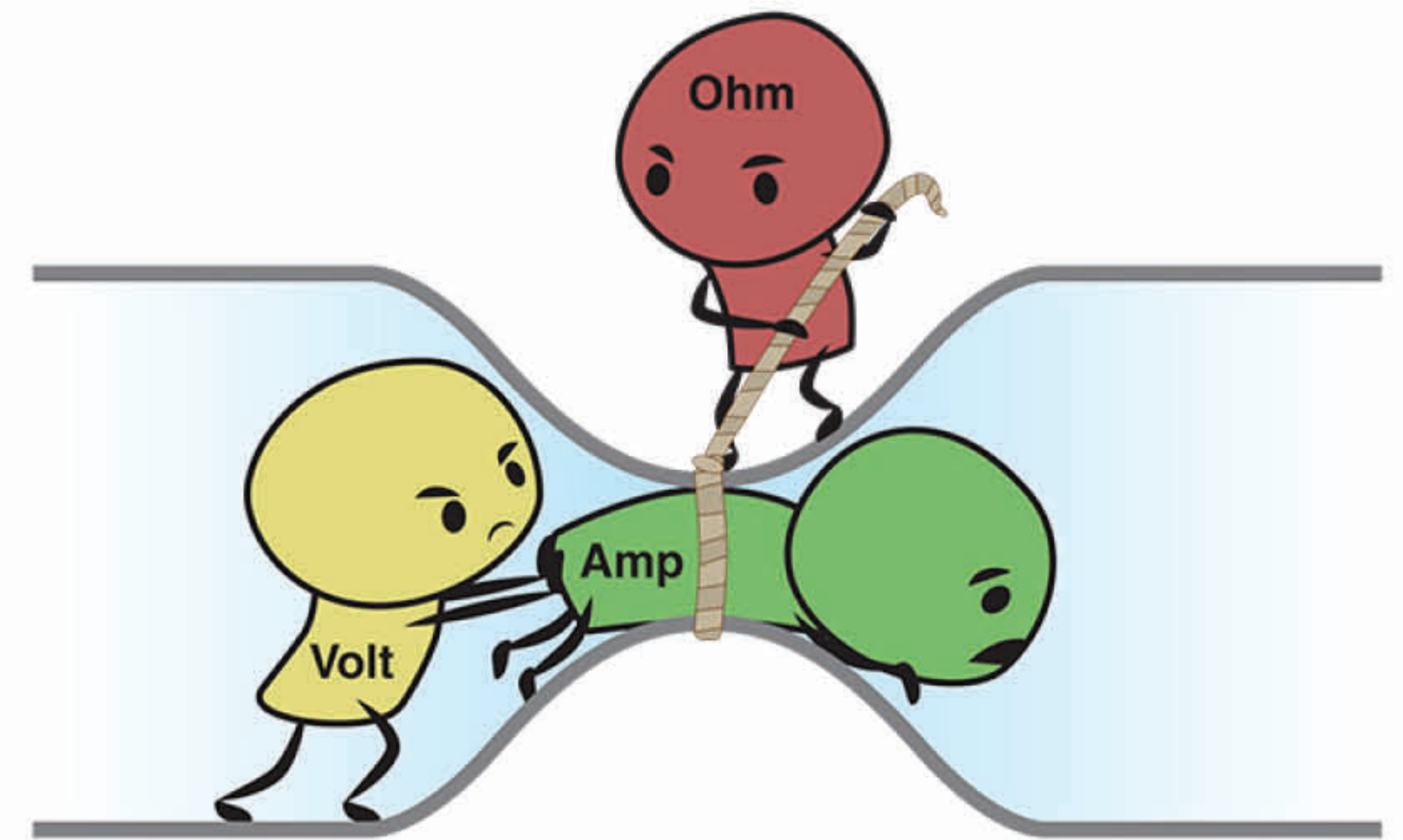
- When two conductors that have the same potential are connected, no electric current passes.**
Because there is no potential difference between them.
- The voltmeter is connected across the two ends of a conductor.**
To measure the potential difference across the two terminals of the conductor.
- The voltmeter is connected across the two poles of a battery**
To measure the electromotive force of the battery.

Electric resistance (resistor)

Electric resistance

It is the opposition that the electric current faces during its passing through a conductor.

- ★ The measuring unit of electric resistance is "**Ohm**".
- ★ Electric resistance is measured with "**Ohmmeter**".



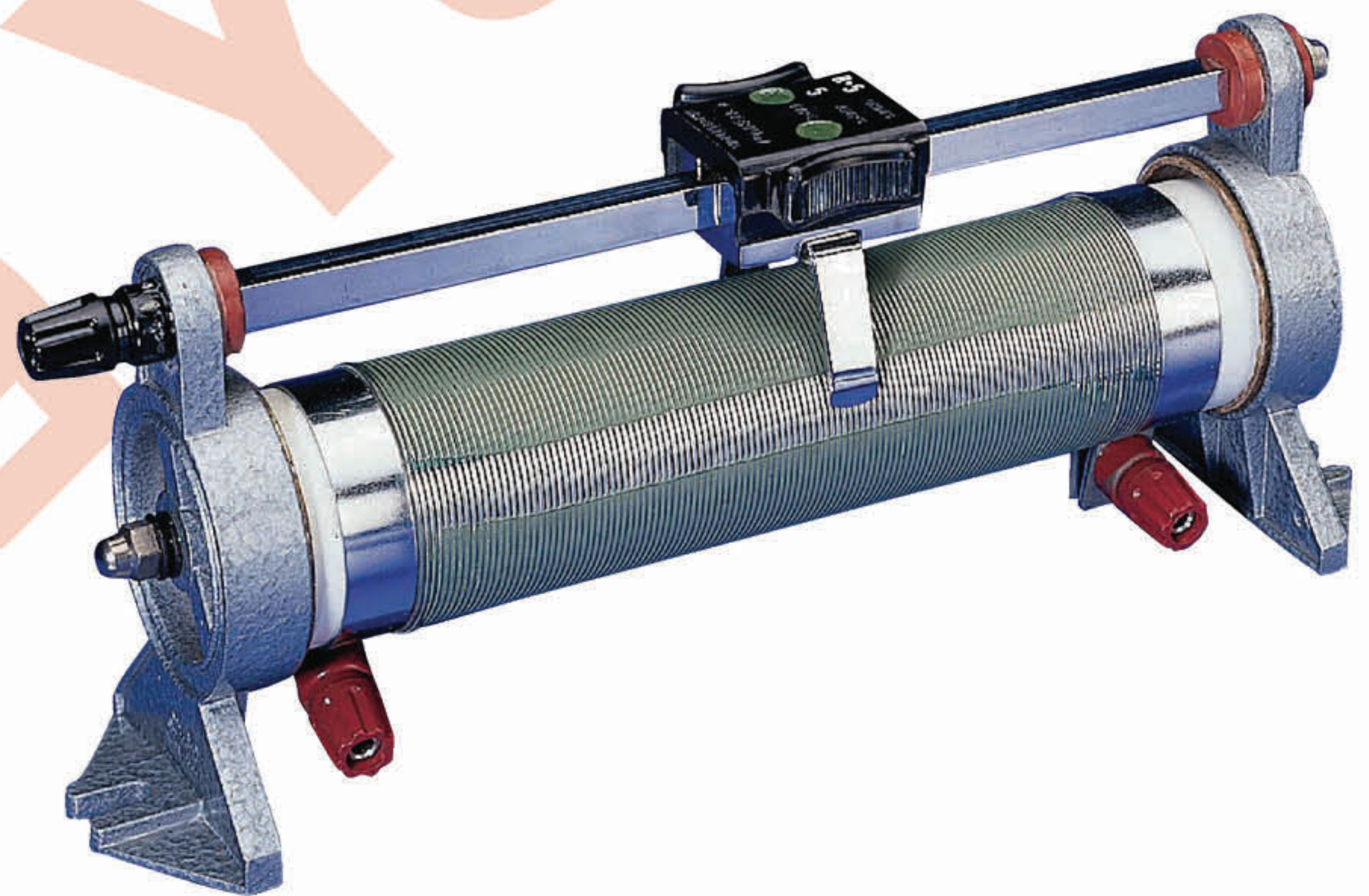
The ohm

It is the resistance between two points of a conductor when a constant potential difference of 1 volt, applied to these points, produces a current of 1 ampere in the conductor.

The variable resistance (Sliding rheostat)

Structure

- A metallic wire of high resistance coiled around a cylinder made of an insulating substance as porcelain and the two terminals of the wire are fixed by two connecting nails.
- A thin copper sheet that has a sliding contact (slider) that can be moved along the wire length and there is a nail (B) connected to this copper sheet to fix the wire from which the current exits.



Importance

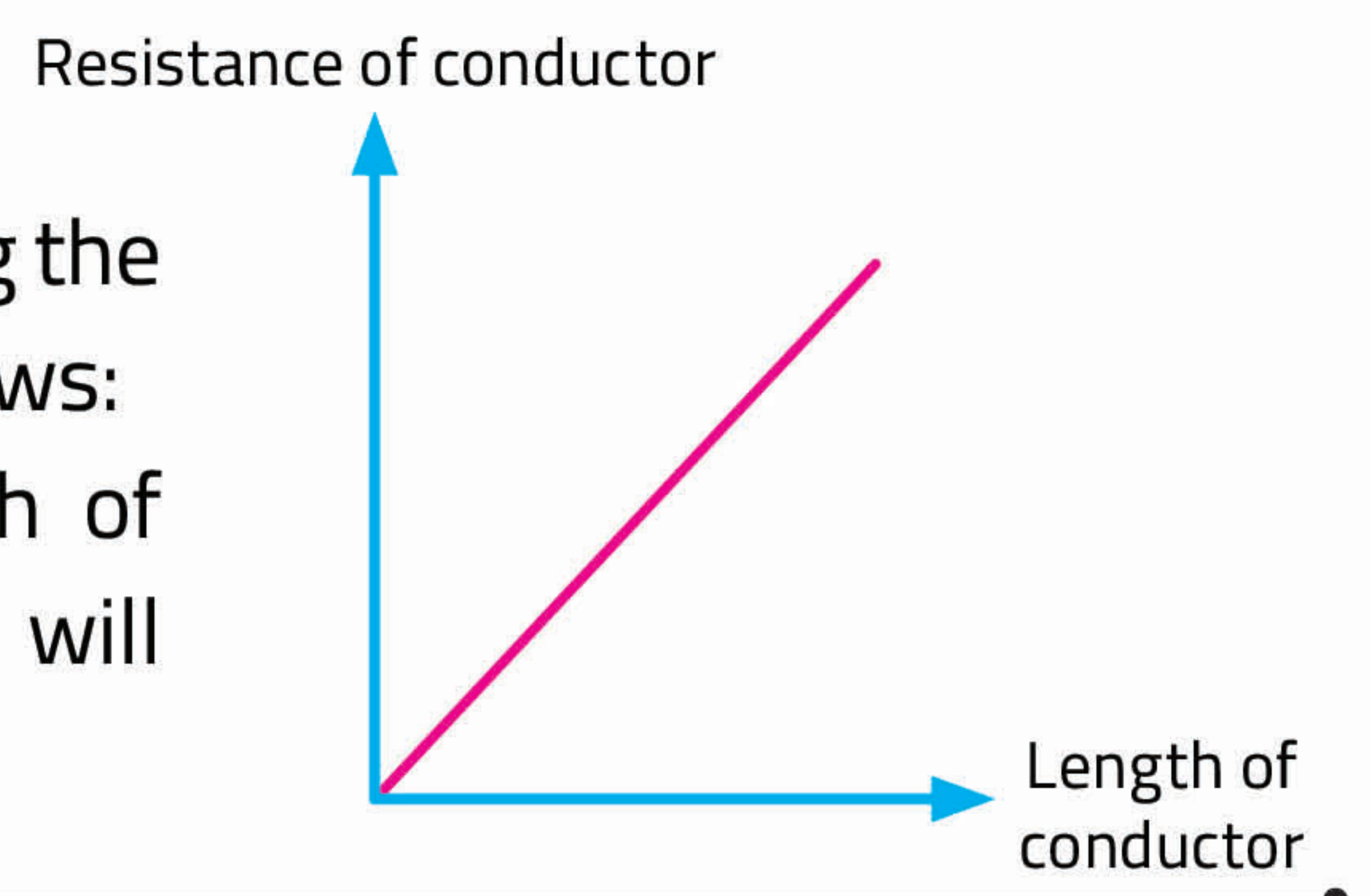
It is used to control the electric current intensity flowing through the circuit and the potential difference in the different parts of the circuits.

Scientific base

The resistance of a conductor (wire) is directly proportional to its length.

Idea of operation

We can control the value of the resistance by controlling the length of the wire that enters the electric circuit as follows: By sliding the flexible sheet on the wire, the length of this wire will change then the value of the resistance will change, so the current intensity will change also.



Lesson 1

Science

The variable resistance (Sliding rheostat)

It is the resistance that you can change its value in order to adjust the value of the current intensity and the potential difference in the different parts of the circuit.

Types of electric resistance

1 The constant (fixed) resistance:

Its symbol in the electric circuit is



2 Variable resistance (Sliding rheostat):

Its symbol in the electric circuit is



P.O.C	Potential difference (V)	Current intensity (I)	Current intensity (R)
Measuring unit	Volt	Ampere	Ohm
Apparatus used	Voltmeter	Ammeter	Ohmmeter

GIVE REASON

1 The rheostat is used in the electric circuit.

To control the electric current intensity passing through the circuit and the potential difference in different parts of the circuit.

2 The rheostat controls the current intensity flowing through the electric circuit.

Because if we increase the length of the wire, the resistance increases and the current intensity decreases and vice versa.





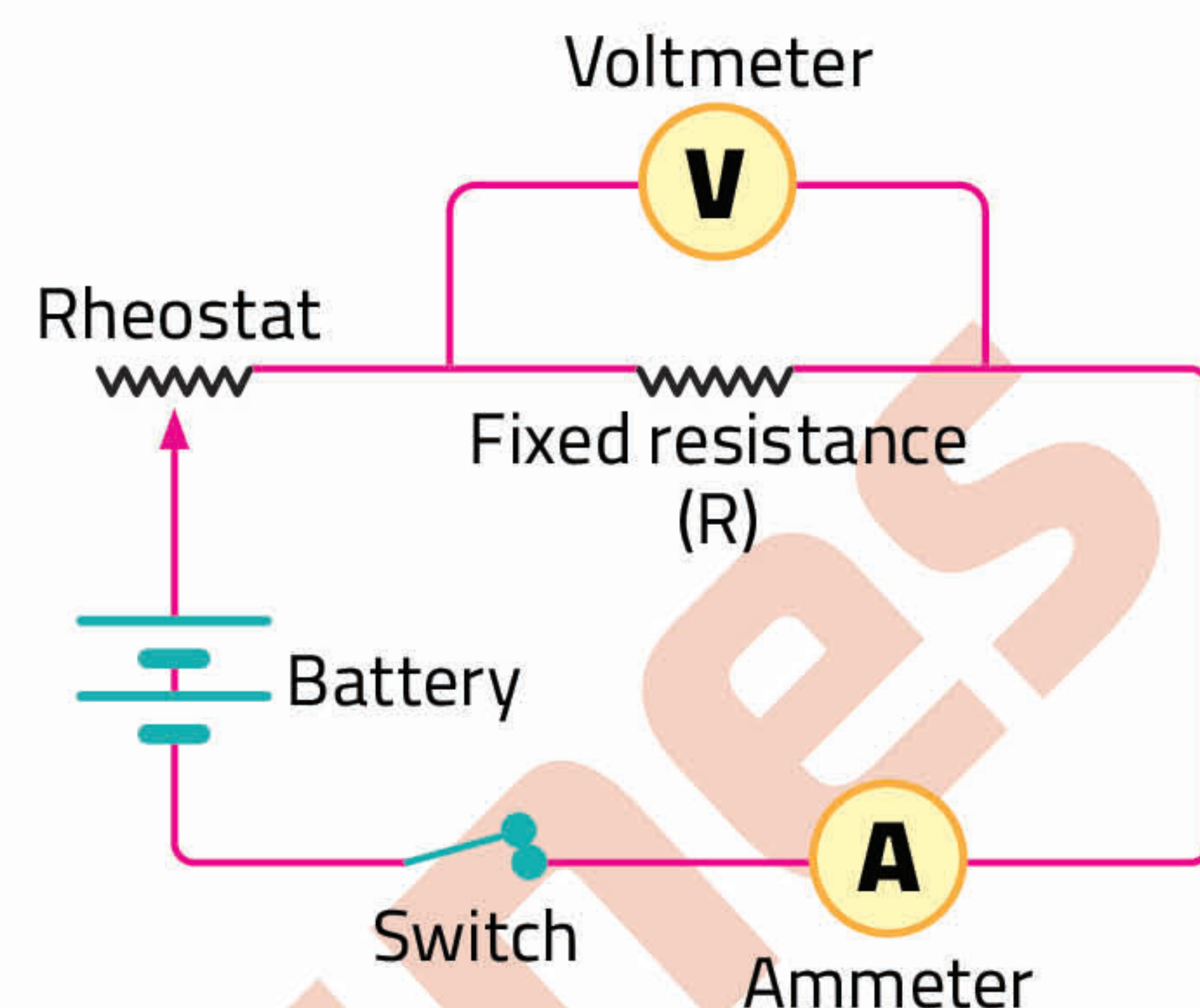
Activity

To discover the relation between current intensity and potential difference:



Steps

1. Connect an electric circuit consisting a battery, a rheostat, a voltmeter, a conductor, an ammeter, and a key.
2. Close the key, then adjust the rheostat and record your reading.
3. Repeat the previous step several times.
4. Calculate the value of $\frac{V}{I}$ in each case.



Exp. No.	Ammeter reading I (ampere)	Voltmeter reading V (volt)	$R = \frac{V}{I}$
1	0.1	1	10
2	0.2	2	10
3	0.3	3	10



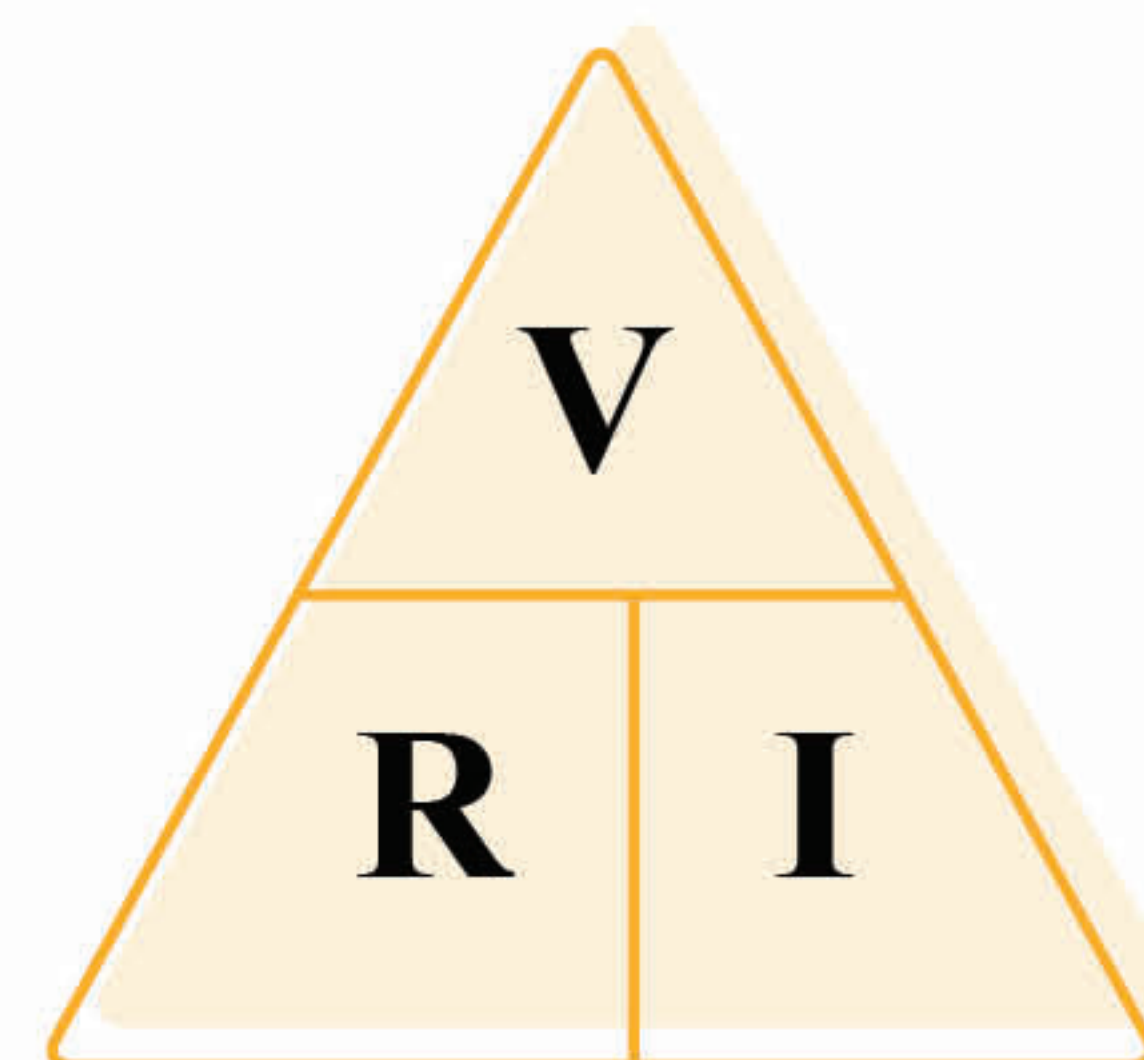
Observation

The ratio = $\frac{\text{Potential difference (V)}}{\text{Current intensity (I)}} = \text{constant value.}$

$$V = \text{constant} \times I \quad V \propto I$$

This constant value represents the **resistance** of the conductor.

$$\text{Electric resistance (R)} = \frac{\text{Potential difference (V)}}{\text{Current intensity (I)}}$$



Conclusion

The electric current intensity passing through the constant (fixed) resistance is directly proportional to the potential difference between its terminals. This is **Ohm's law**.

Ohm's law

The electric current intensity passing through a conductor is directly proportional to the potential difference across it at a constant temperature.

Electric resistance of a conductor

It is the ratio between the potential difference across the two ends of a conductor (resistor) and the current intensity passing through it.

The ohm

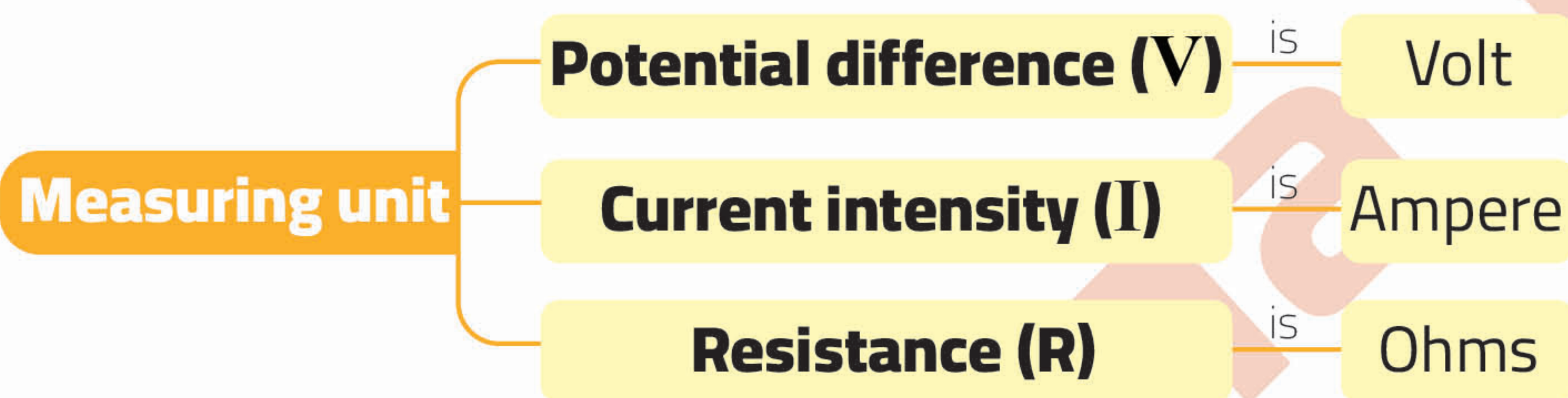
It is the resistance of a conductor which allows passing an electric current intensity of one ampere when the potential difference between its terminals is one volt.

The ampere

It is the current intensity passing through a conductor whose resistance is one ohm and the potential difference between its terminals is one volt.

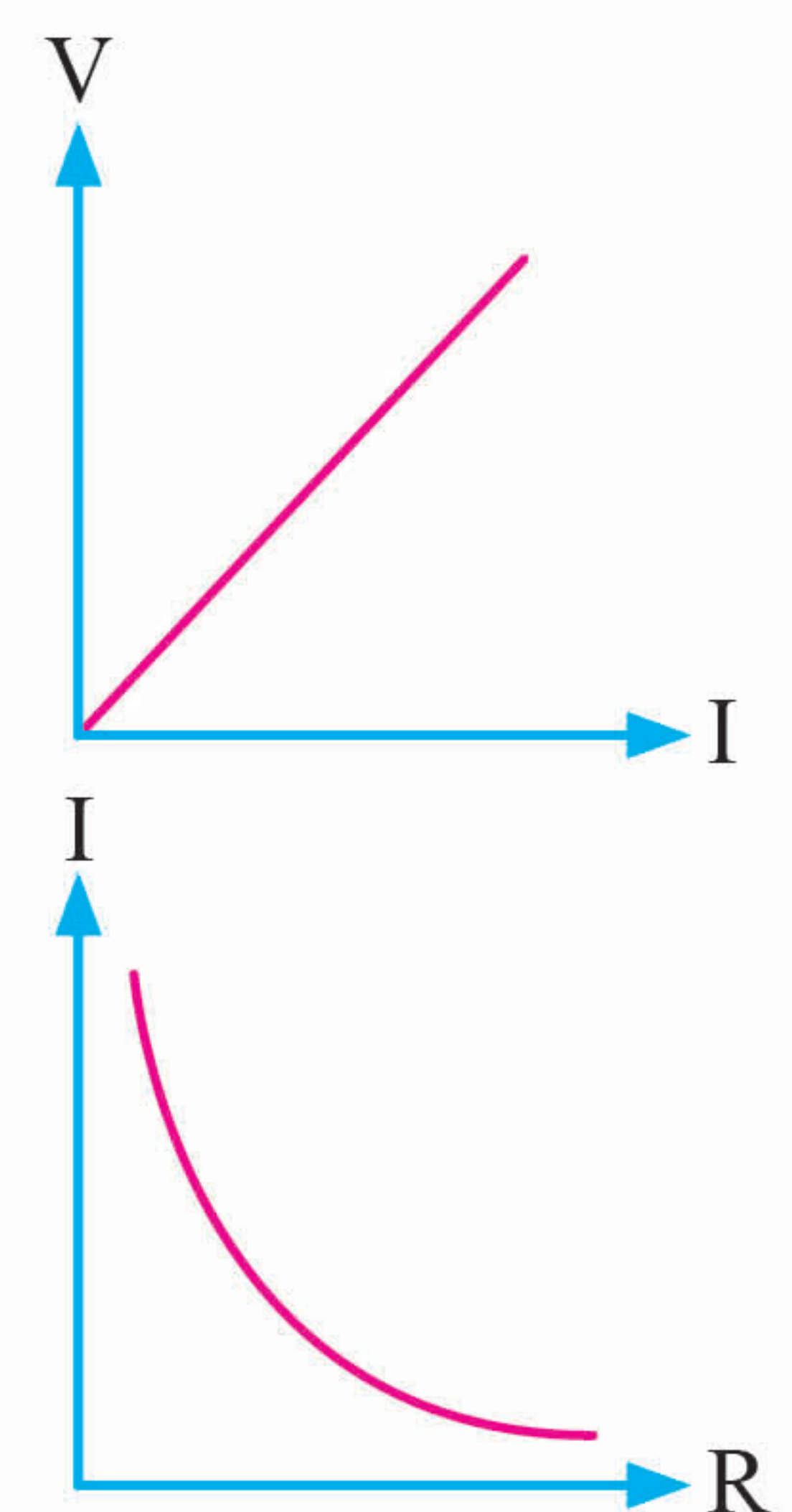
The volt

It is the potential difference across the two terminals of a conductor whose resistance is one ohm and the current intensity passing through it is one ampere.



★ **Electric potential difference (V)** is **directly** proportional to the **current intensity (I)**, at **constant temperature**.

★ **Current intensity (I)** is **inversely** proportional to the **resistance (R)**, at **constant potential difference**.



WHAT IS MEANT BY?

1 **The resistance of a conductor = 25 ohm.**

This means that the ratio between the potential difference across the two ends of a conductor and the current intensity passing through it = 25 ohm.

WHAT HAPPENS WHEN

- 1 Burning of the fixed resistance in an electric circuit (concerning: the reading of an ammeter connected to the circuit in series and that of a voltmeter connected to the battery in parallel).**

The reading of the ammeter = zero, but the reading of the voltmeter still as it is.

- 2 Increasing the potential difference between the two terminals of a conductor to double its value, at constant temperature (concerning: the electric current intensity).**

The electric current intensity will increase to double its value.

- 3 Increasing the value of the electric resistance to double its value, at constant temperature (concerning the electric current intensity).**

The electric current intensity will decrease to half its value.

SOLVED PROBLEMS

- 1 If an electric current of 0.2 ampere passes through an electric heater and the potential difference between its two ends is 220 volt, calculate the heater's resistance.**

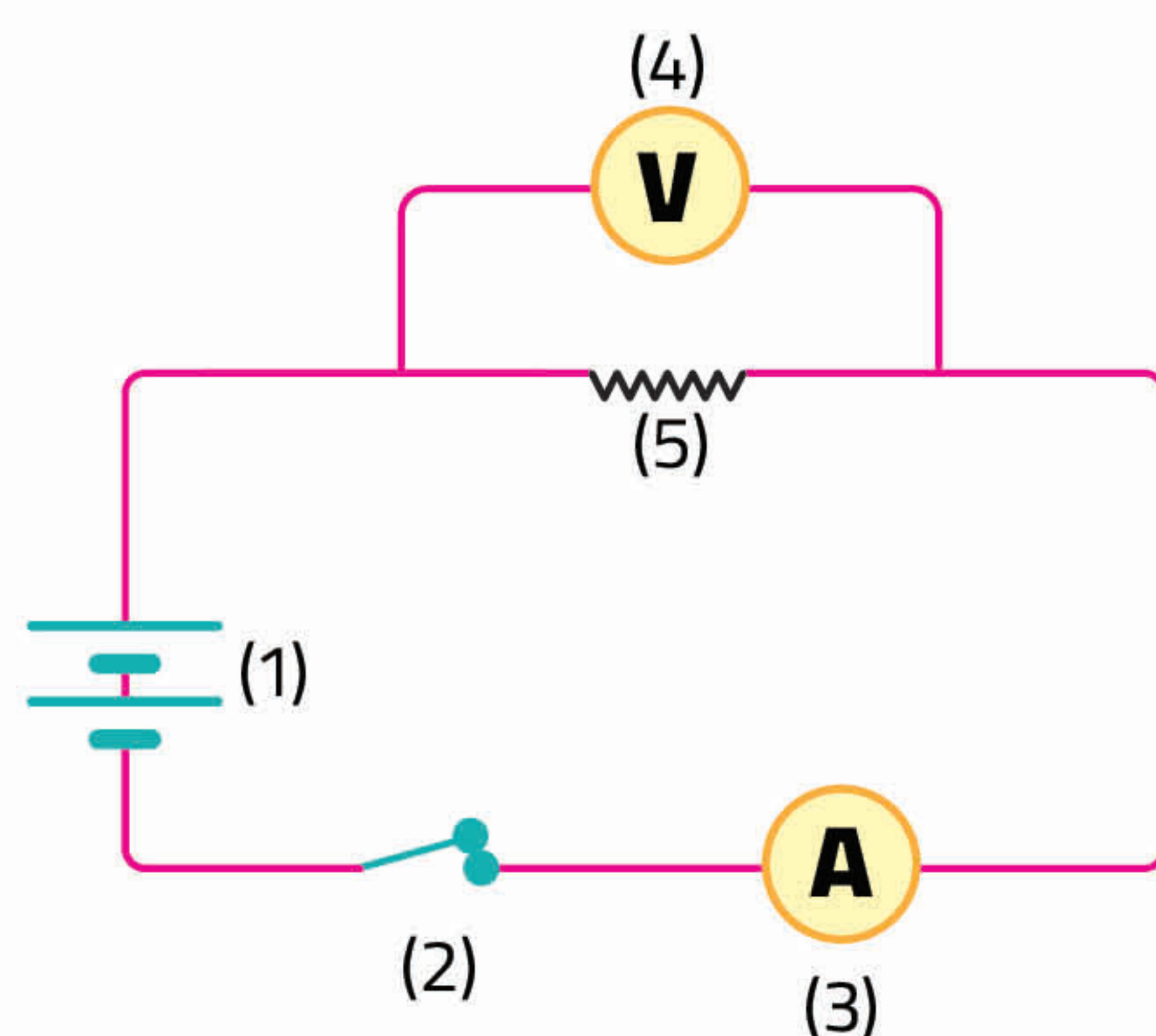
Sol

$$\begin{aligned} \text{Electric resistance (R)} &= \frac{\text{Potential difference (V)}}{\text{Current intensity (I)}} \\ &= \frac{220}{0.2} = 1100 \text{ ohm} \end{aligned}$$

- 2 Label the parts of the opposite electric circuit, then calculate the value of (R).**

Sol

.....



- 3 Calculate the quantity of charge passes through a conductor, its resistance equals 1000 ohm for 30 min. if the potential difference between its poles equals 220 volt.**

Sol

$$\begin{aligned} I &= \frac{V}{R} = \frac{220}{1000} = 0.22 \text{ Amp.} \\ q &= I \times t = 0.22 \times 1800 = 396 \text{ Coulomb} \end{aligned}$$

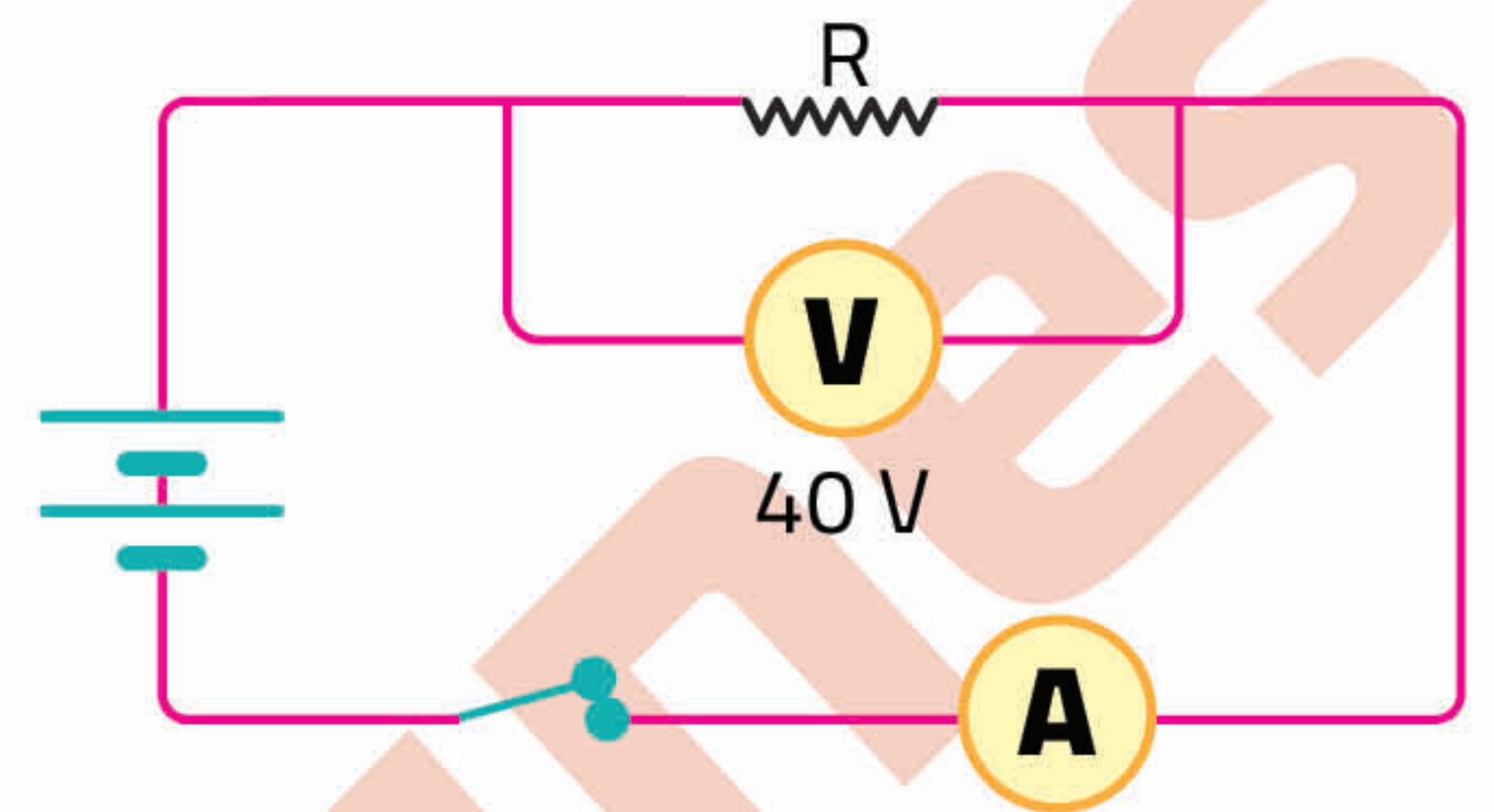
- 4** Calculate the amount of work needed to pass an electric charge 500 coulomb across a conductor with a resistance 3 ohm and the electric current intensity passes through is 2 amp.

Sol

$$V = R \times I = 3 \times 2 = 6 \text{ Volt}$$

$$W = V \times q = 6 \times 500 = 3000 \text{ Joule}$$

- 5** In the opposite figure: Calculate the current intensity passing, if the work done to transfer the electric charge is 240 Joule and the time of flowing is 2 second.



- 4** Calculate the quantity of electricity that passes through a conductor of resistance 2200 ohm for two minutes, if the potential difference between its terminals equal 220 volt.

- 4** If the potential difference between the two terminals of a conductor is 6 volt, and an electric current intensity 0.5 ampere passes through it. Calculate the intensity of the electric current passing through this conductor if it is connected to a voltage source of 12 volt.

- 4** Calculate the work done to pass electric charge equals 300 coulomb across a conductor of resistance 5 ohm and current intensity 3 ampere passes through it.

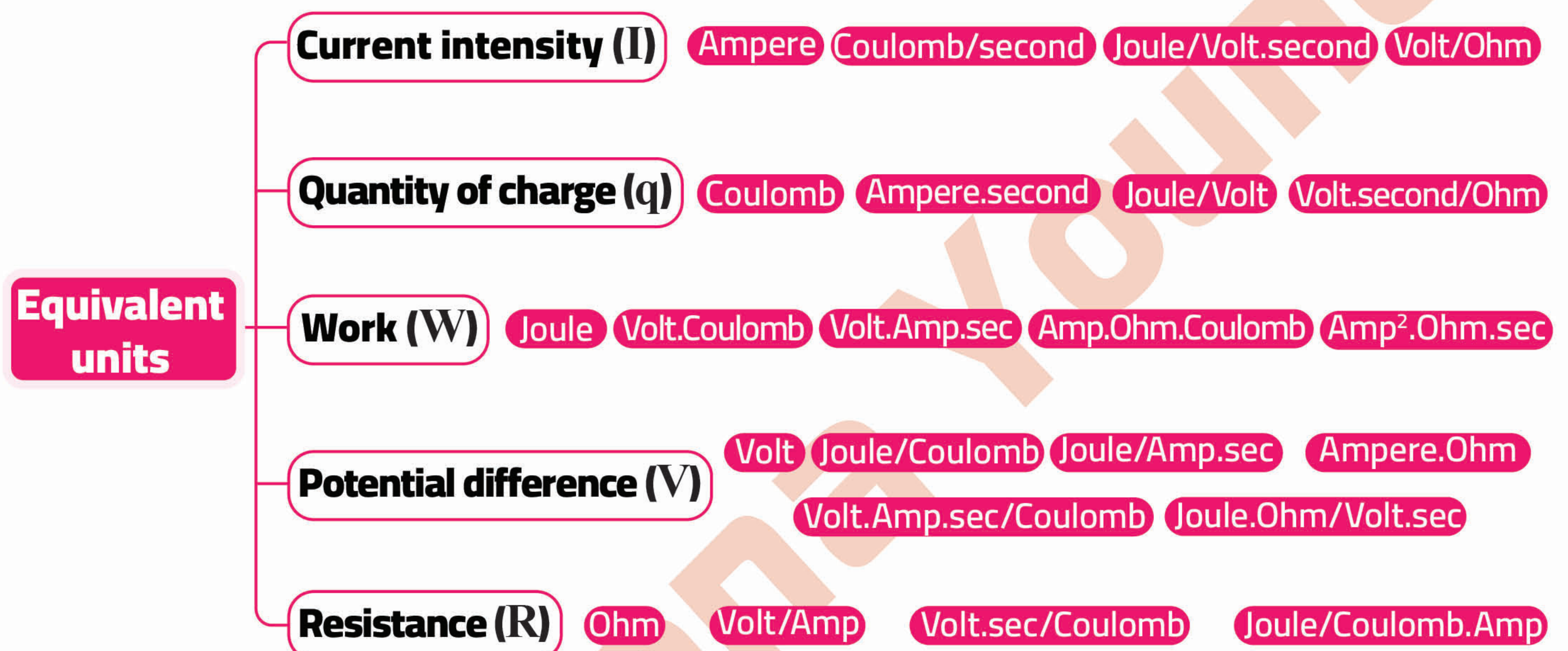
- 1 Calculate the potential difference between the two ends of a vacuum cleaner whose resistance is 22 ohm and the quantity of electricity of 30 coulomb passes for one minute.

.....

.....

.....

.....



Electric current and cells

Sources of the electric current

Electrochemical cells

Electrochemical cells

They are the cells in which the chemical energy is converted into electrical energy.

Chemical energy



Electrochemical cells

Electric energy

Electric generators (Dynamo)

Electric generators (Dynamo)

They are the devices in which the mechanical (kinetic) energy is converted into electric energy.

Kinetic energy



Electric generator

Type of electric current produced

Direct electric current

Alternating electric current

Examples

Dry cells and batteries

Dynamo
(electric generator)



Types of electric current

Direct electric current

Direct electric current

It is an electric current that has a **constant intensity** and flows in **one direction** in the electric circuit.

Electrochemical cells

Constant intensity

Alternating electric current

Electric generators (Dynamo)

It's an electric current that has a **variable intensity** and flows in **two opposite directions** in the electric circuit.

Electric generators

Variable intensity

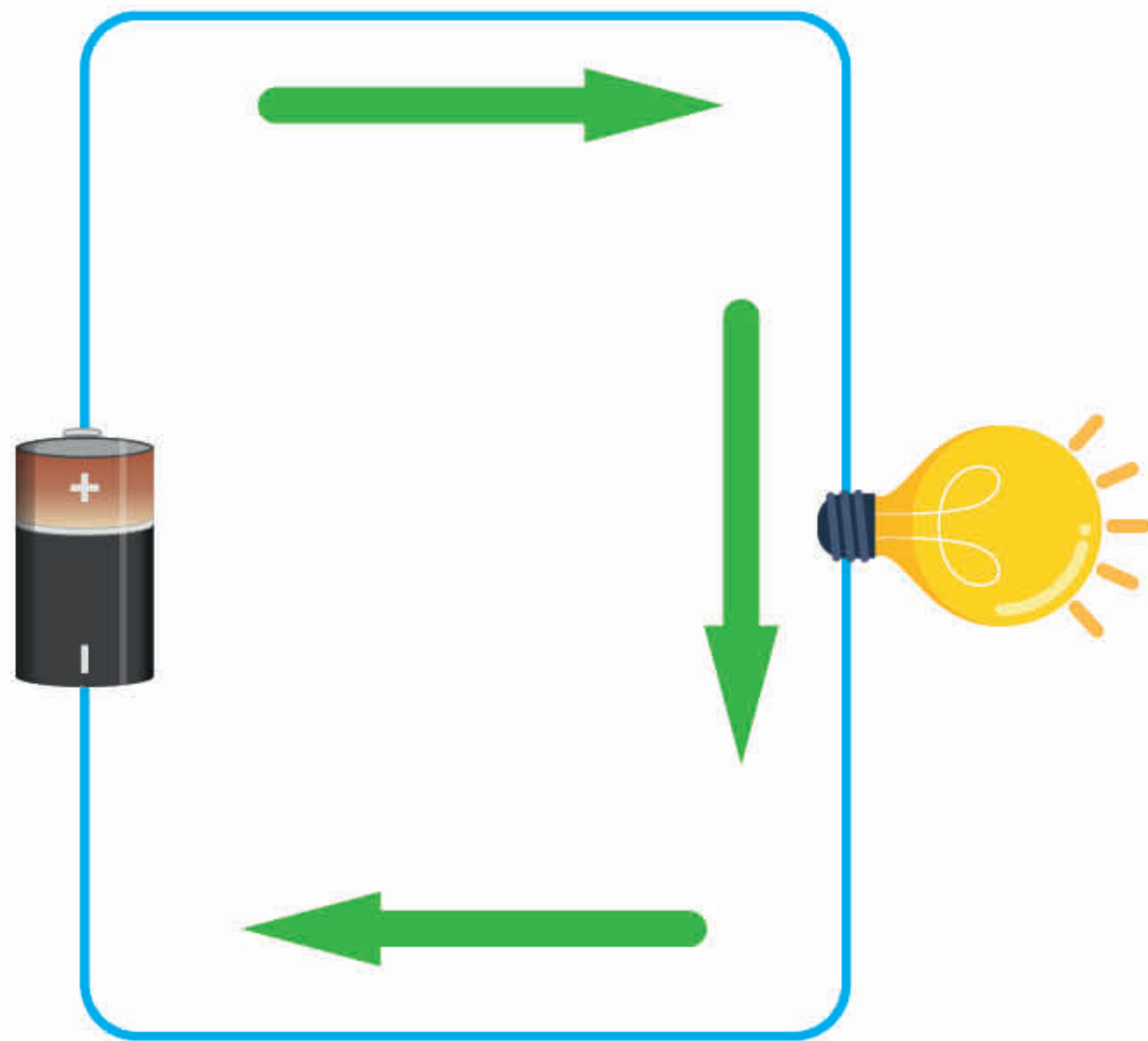
Source

Intensity

Direction

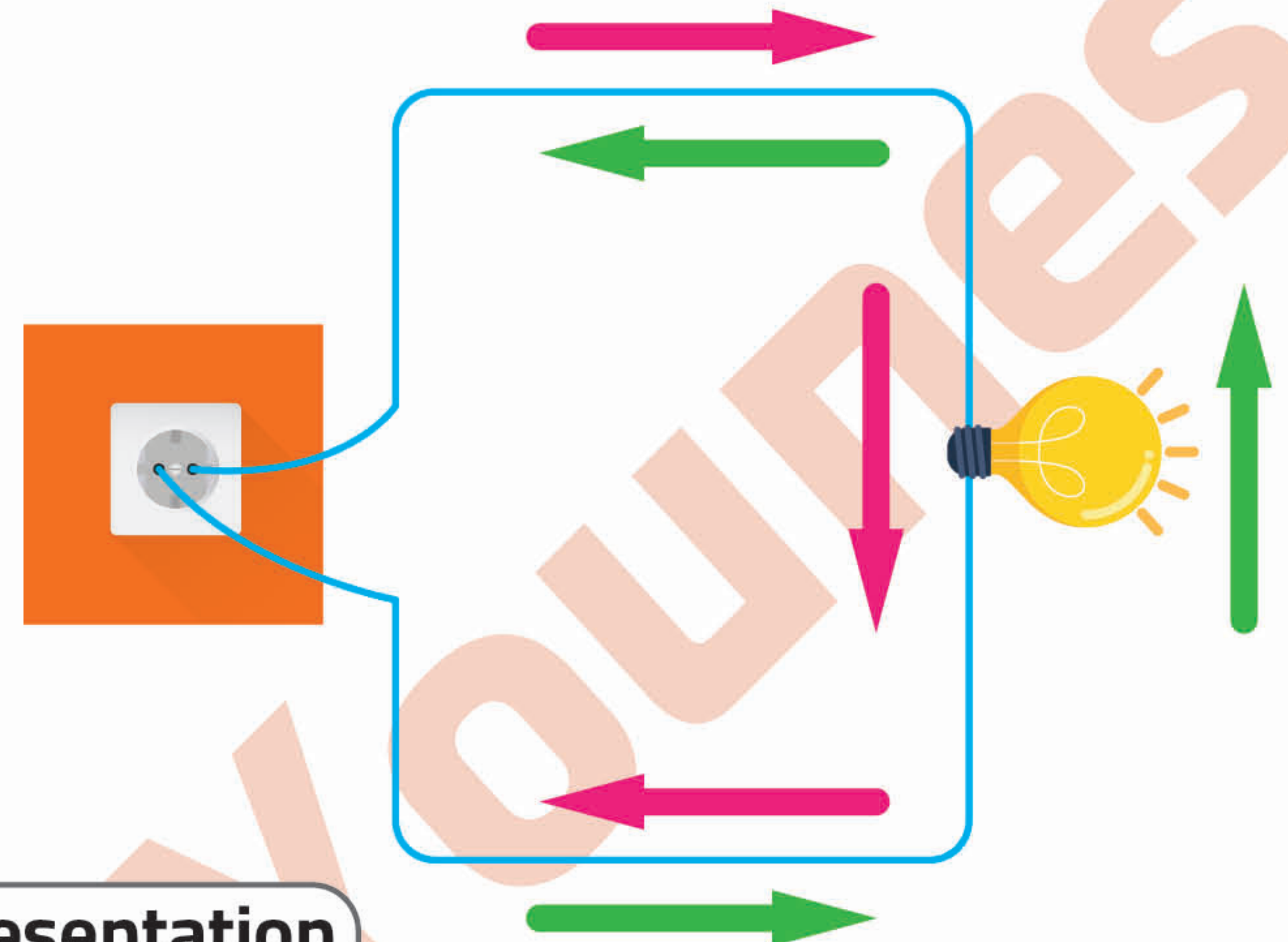
**It is unidirectional
(it flows in one direction).**

The electrons flow from one pole of the electrochemical cell passing through all the components of the circuit to the other pole.

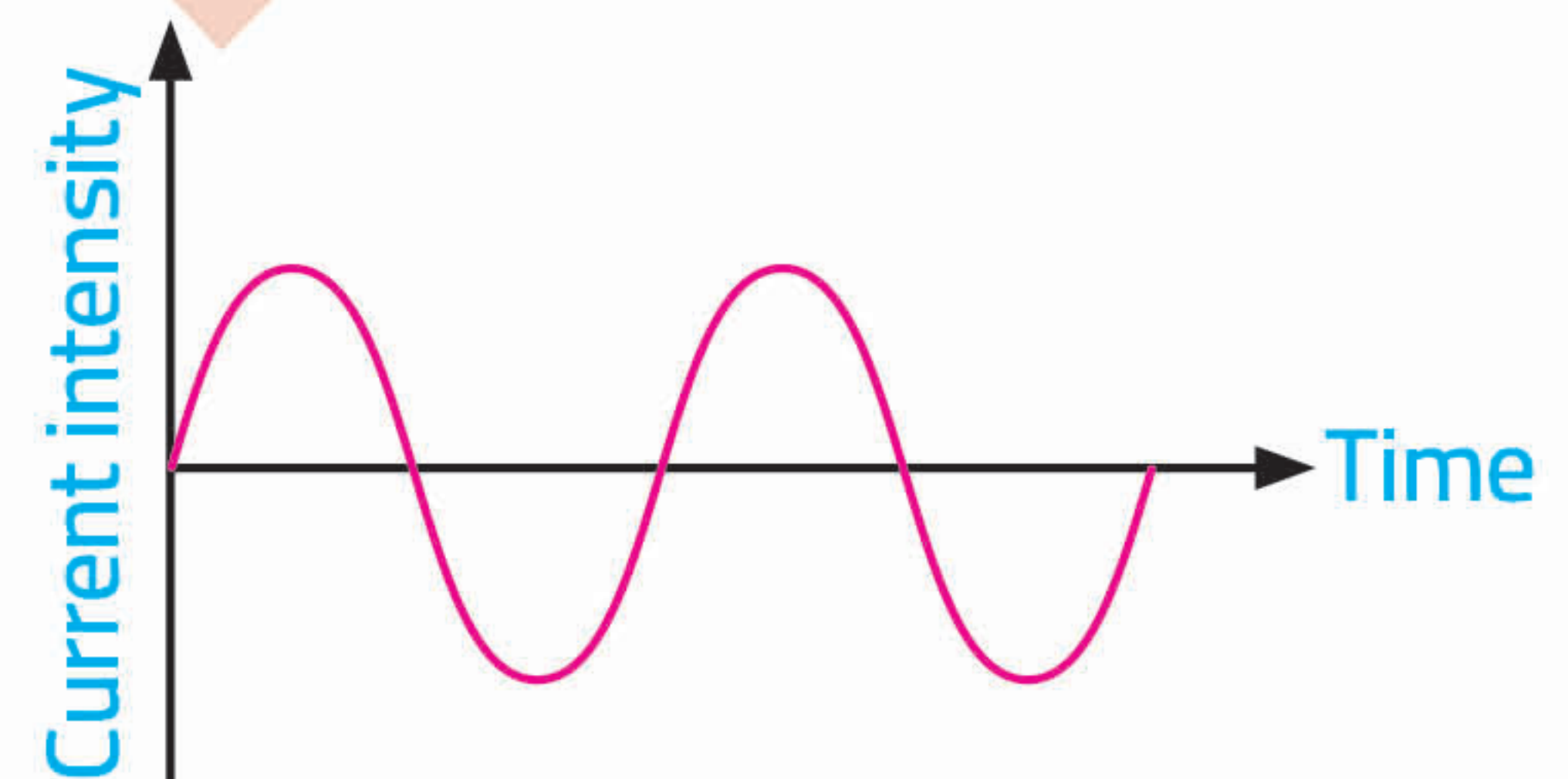


It is variable indirection.

The electrons flow in one direction at the beginning, then starts to flow in the opposite direction and this cycle is repeated many times with high speed.



Graphical representation



Transference

It can be transferred only for short distances.

It can be transferred for short and long distances through wires.

Conversion to the other type

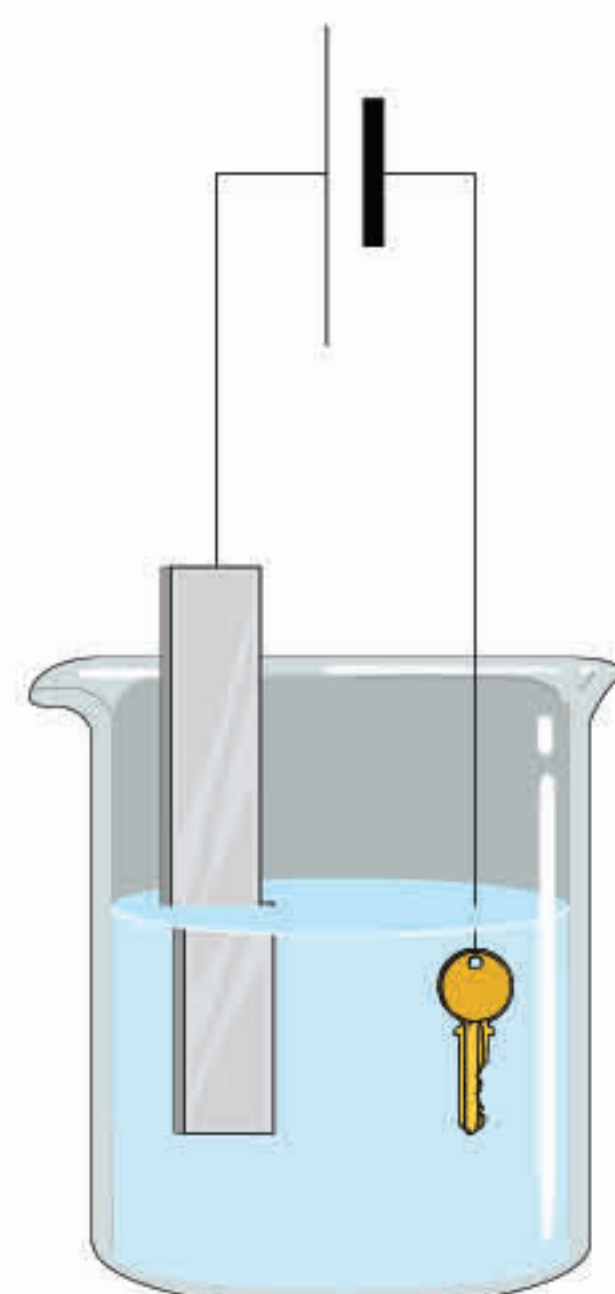
It **cannot** be converted into **an alternating current**.

It **can** be converted into **direct current**.

Uses

It is used in:

- Electroplating processes.
- Operating some electric appliances.



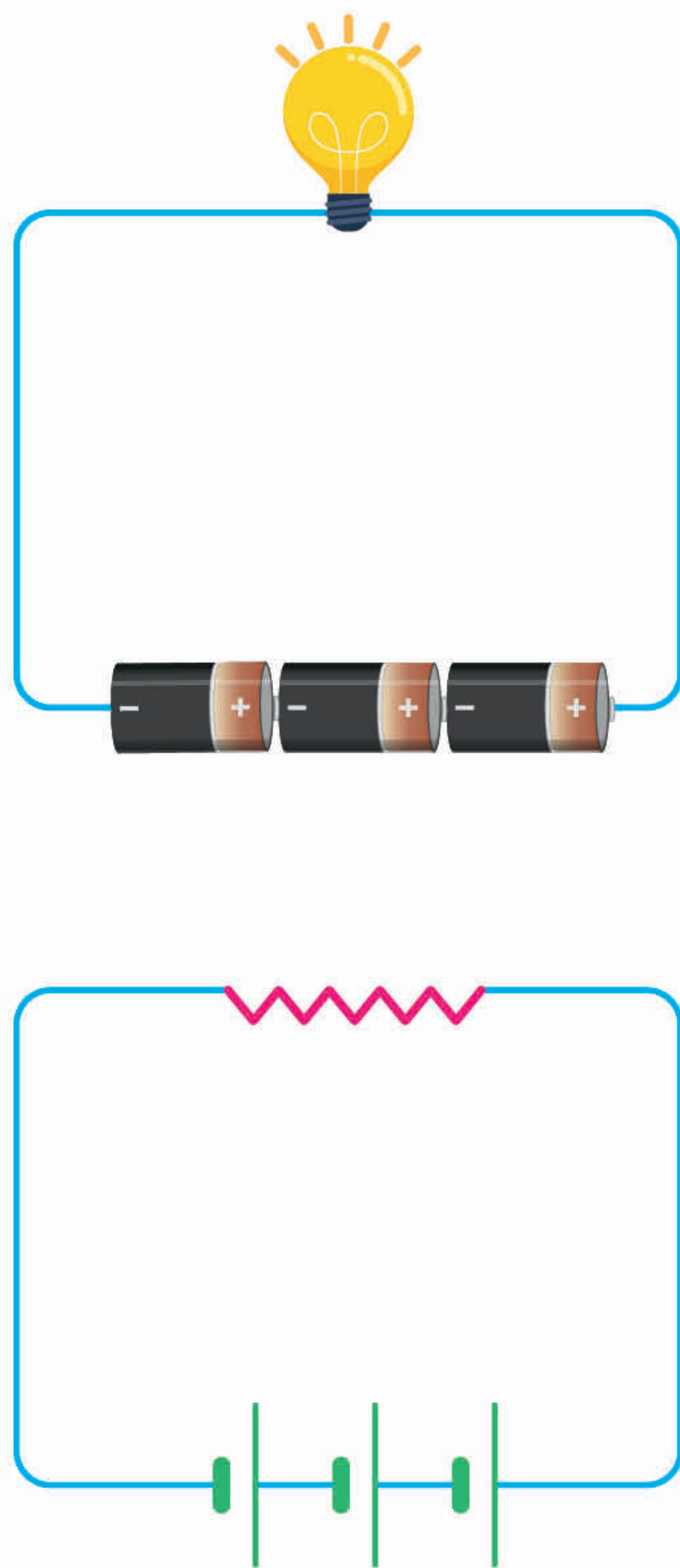
It is used in:

- Lighting houses and streets.
- Operating electric appliances.



Methods of connecting the cells in an electric circuit

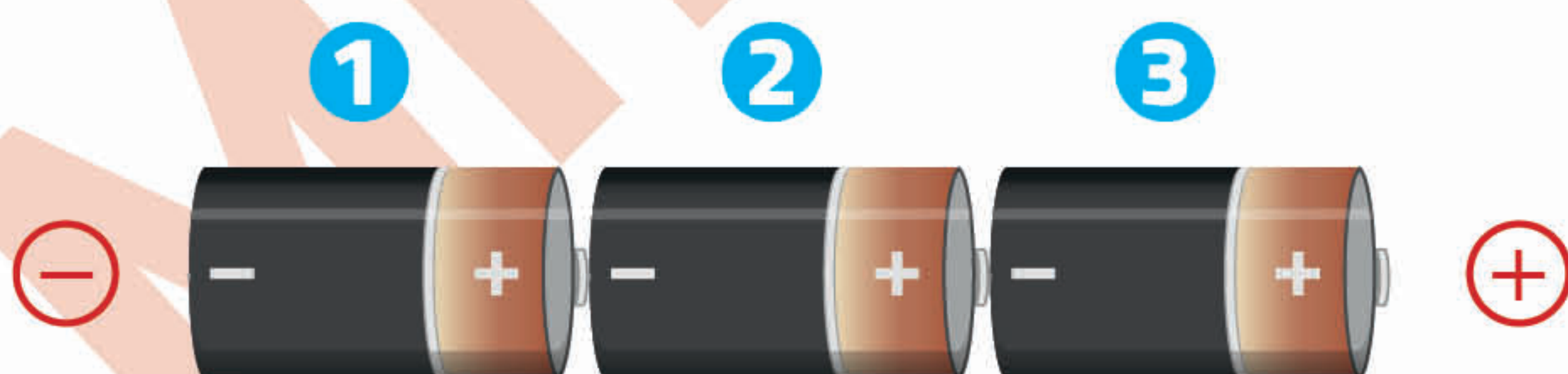
Series connection



Method of connection

Different poles are connected together:

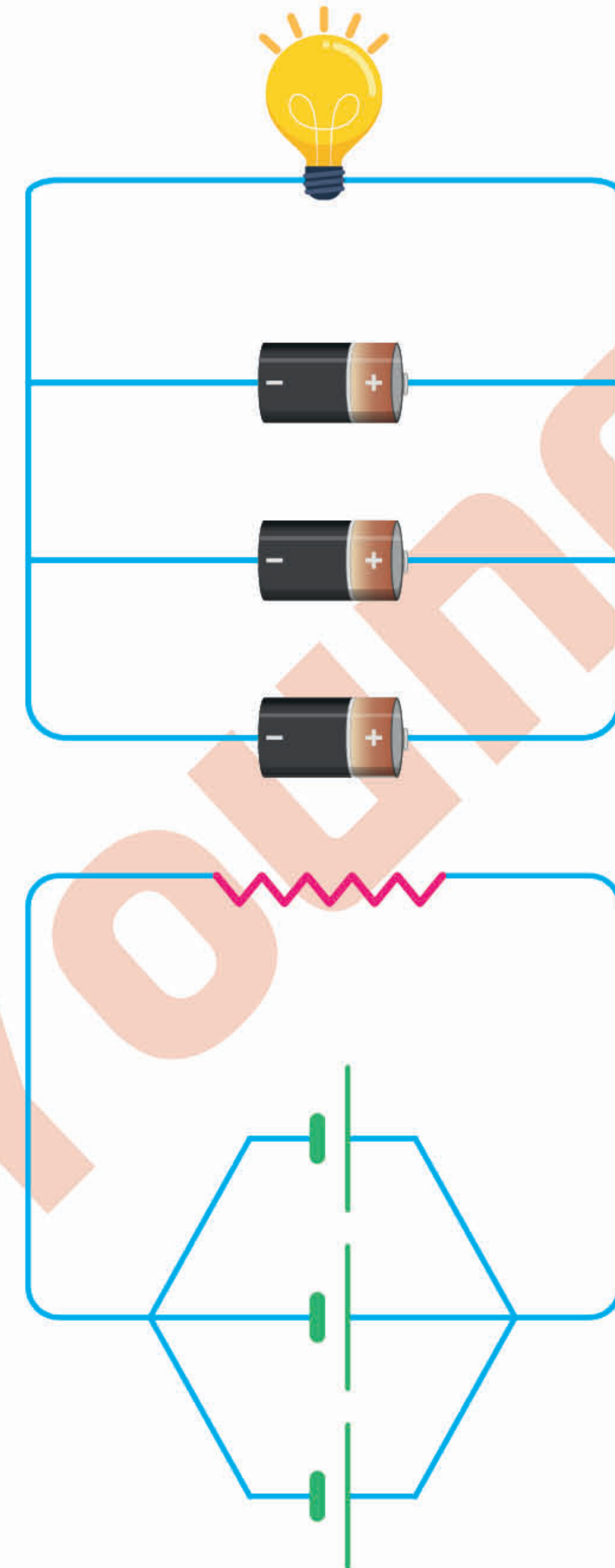
- The **positive pole** of the first cell is connected to the **negative pole** of the second cell.
- The **positive pole** of the second cell is connected to the **negative pole** of the third cell.



Therefore

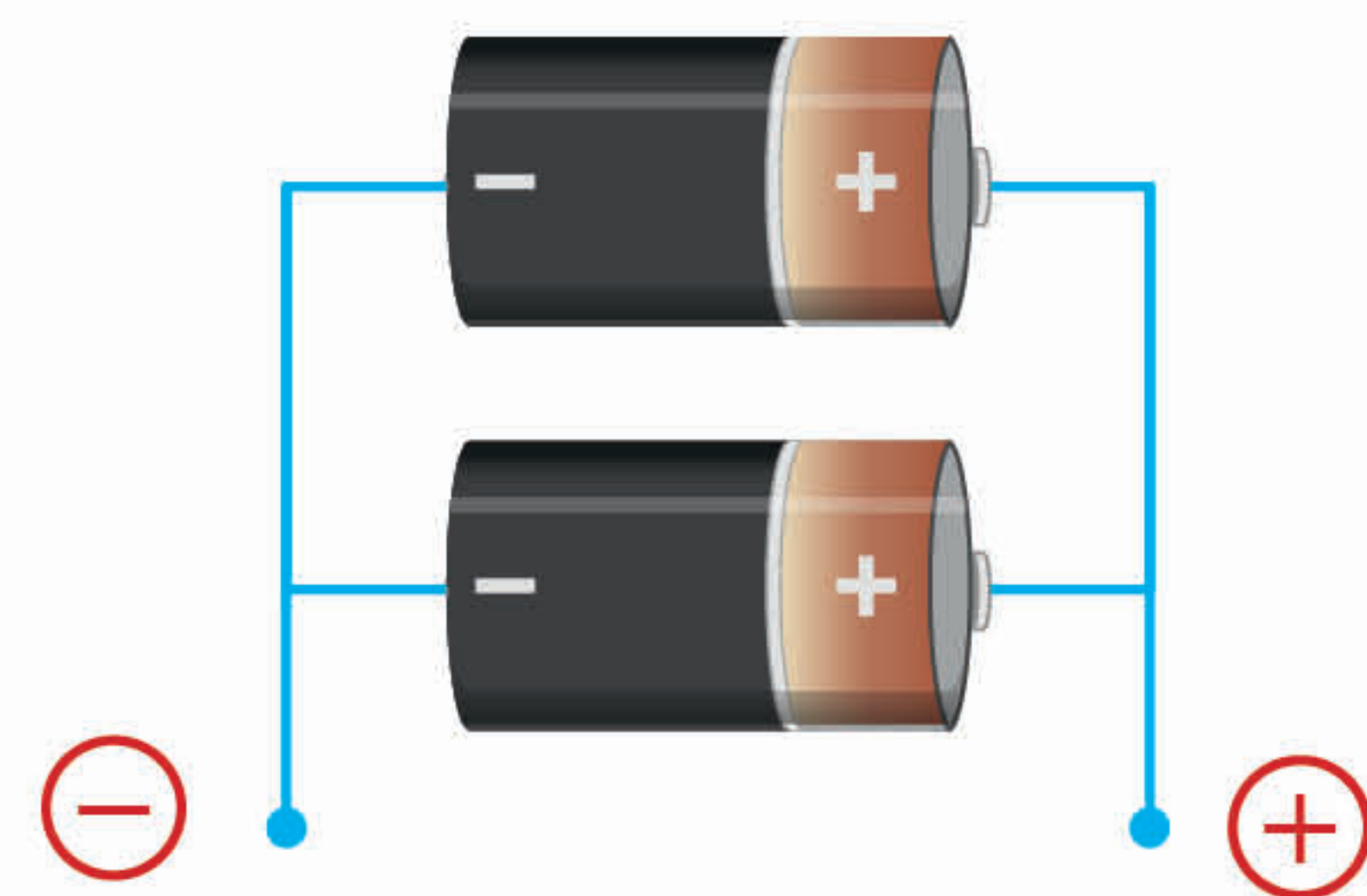
The positive pole of the last cell and the negative pole of the first one are the poles of the battery.

Parallel connection



Similar poles are connected together:

- The **positive poles** of all cells are connected together with one end to act as a positive pole.
- The negative poles of all cells are connected together with one end to act as a negative pole.



There will be one positive pole and one negative pole for the produced battery.

Measuring the electromotive force (e.m.f.)

In series

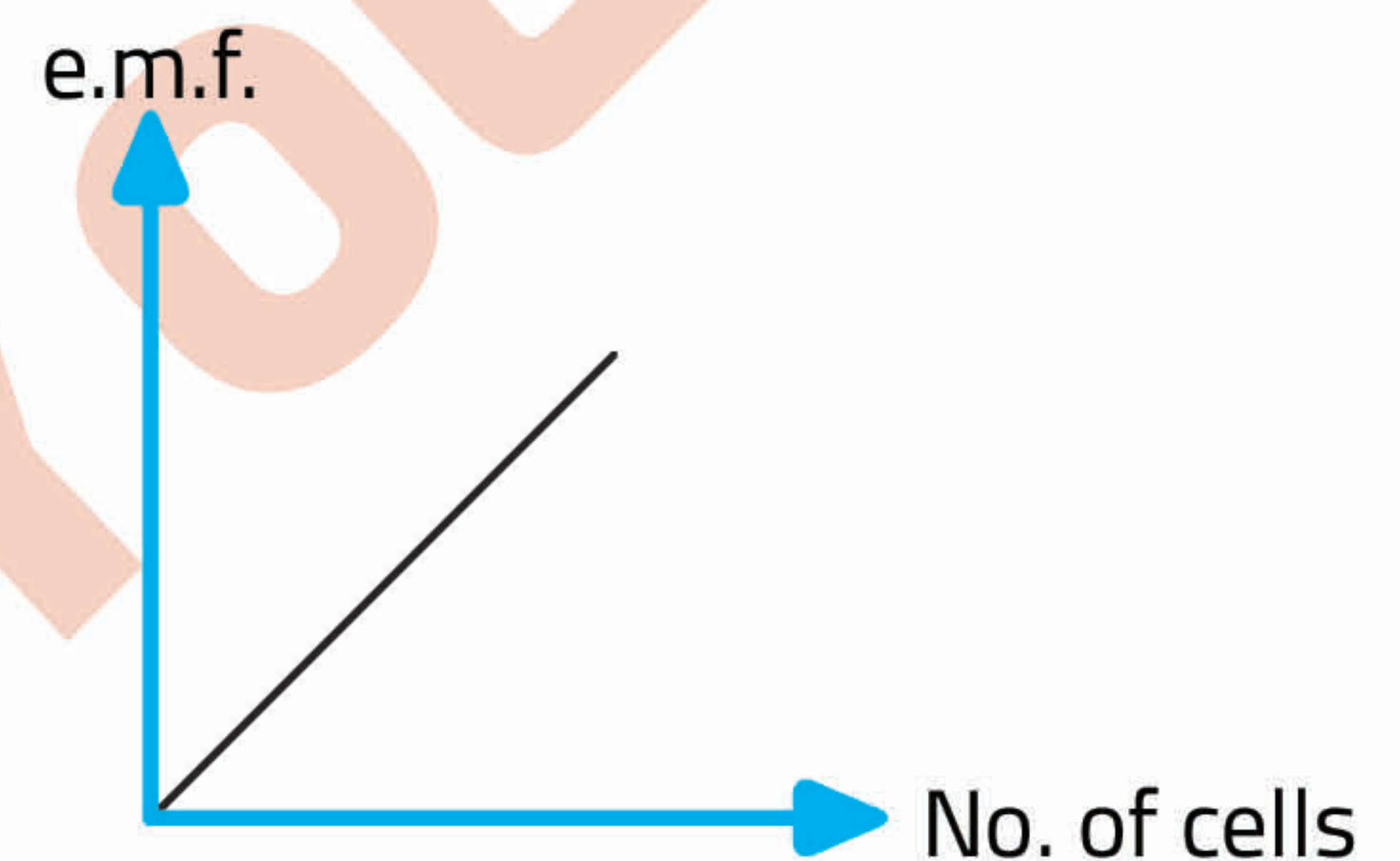
- ★ The electromotive force of a group of **different** dry cells connected **in series** = the sum of the electromotive forces of these cells:

$$E_{\text{battery}} = E_1 + E_2 + E_3 + \dots$$

- ★ The electromotive force of a group of similar dry cells connecting in series = the number of the cells (n) x the electromotive force of one cell.

$$E_{\text{battery}} = n \times E_1$$

- ★ The relation between the electromotive force and the number of similar electric cells connected in series can be represented by the opposite graph.

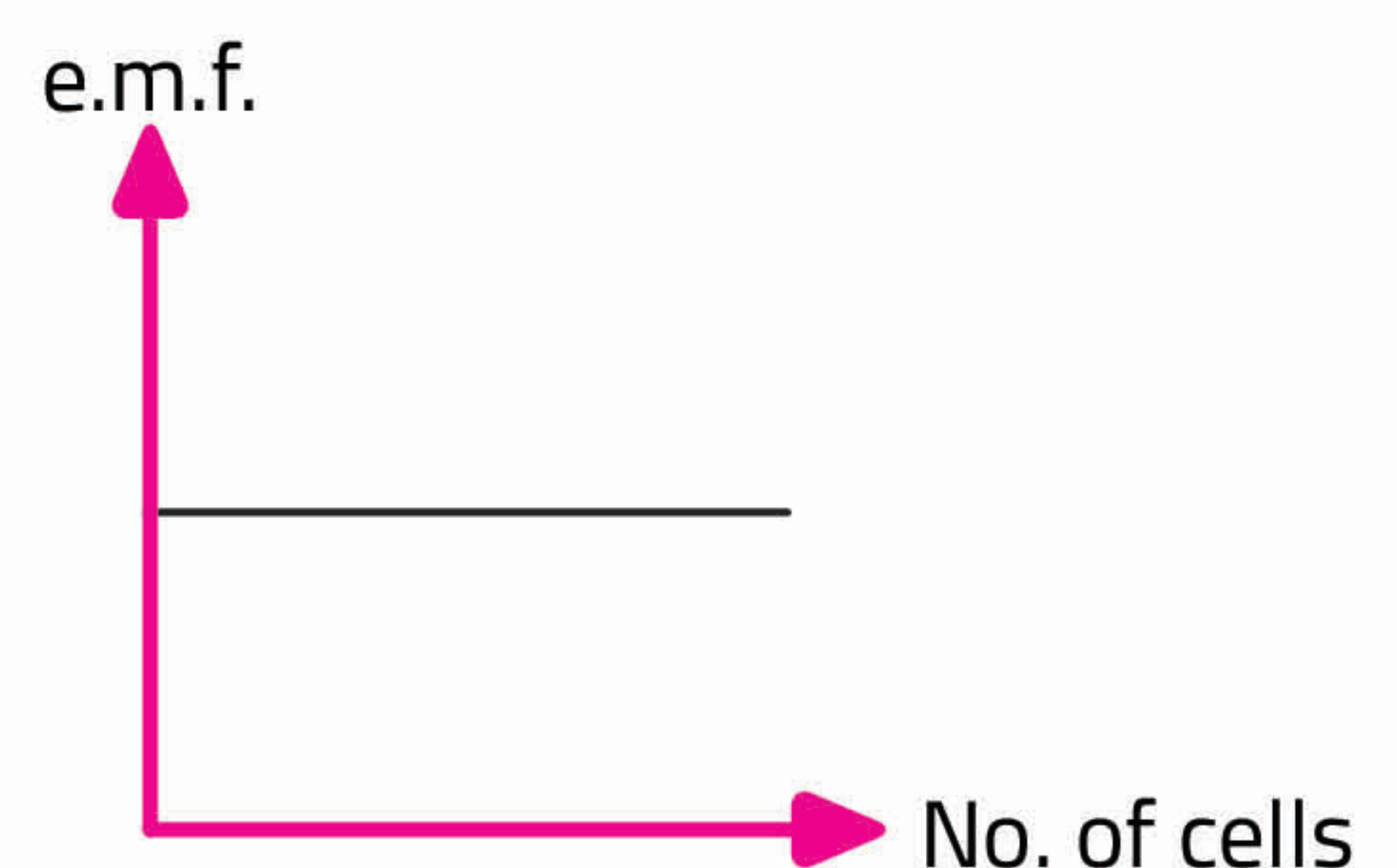


In parallel

- ★ The e.m.f. of a group of similar dry cells which are connected in parallel is equal to the e.m.f. of one cell.

$$E_{\text{battery}} = E_1$$

- ★ The relation between the electromotive force and number of similar electric cells connected in parallel can be represented by the opposite graph.





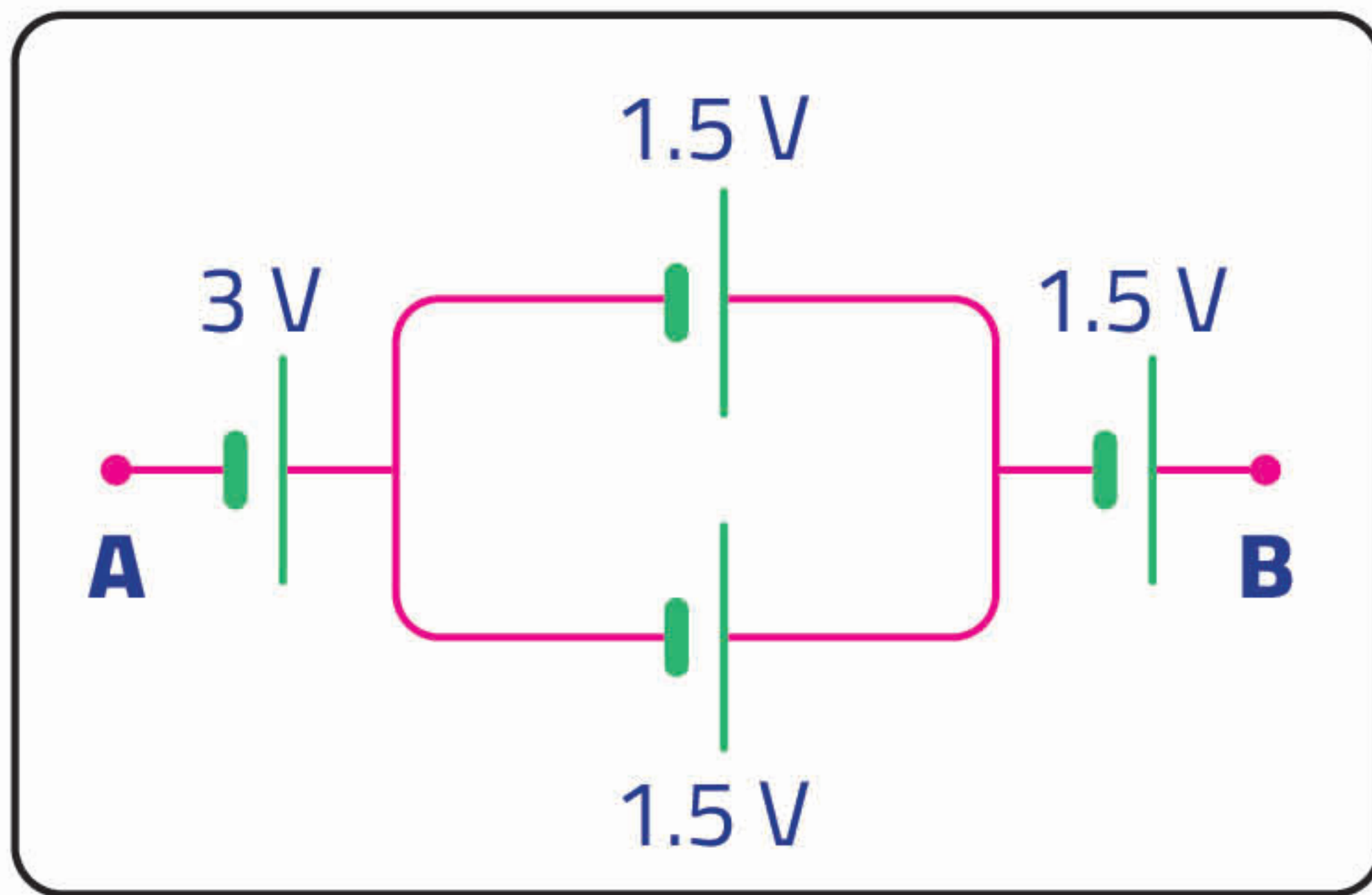
- 1** A battery consists of three cells, three e.m.f. of each cell is 3 volt. Calculate the electromotive force if the electrodes are connected.

(1) In series.

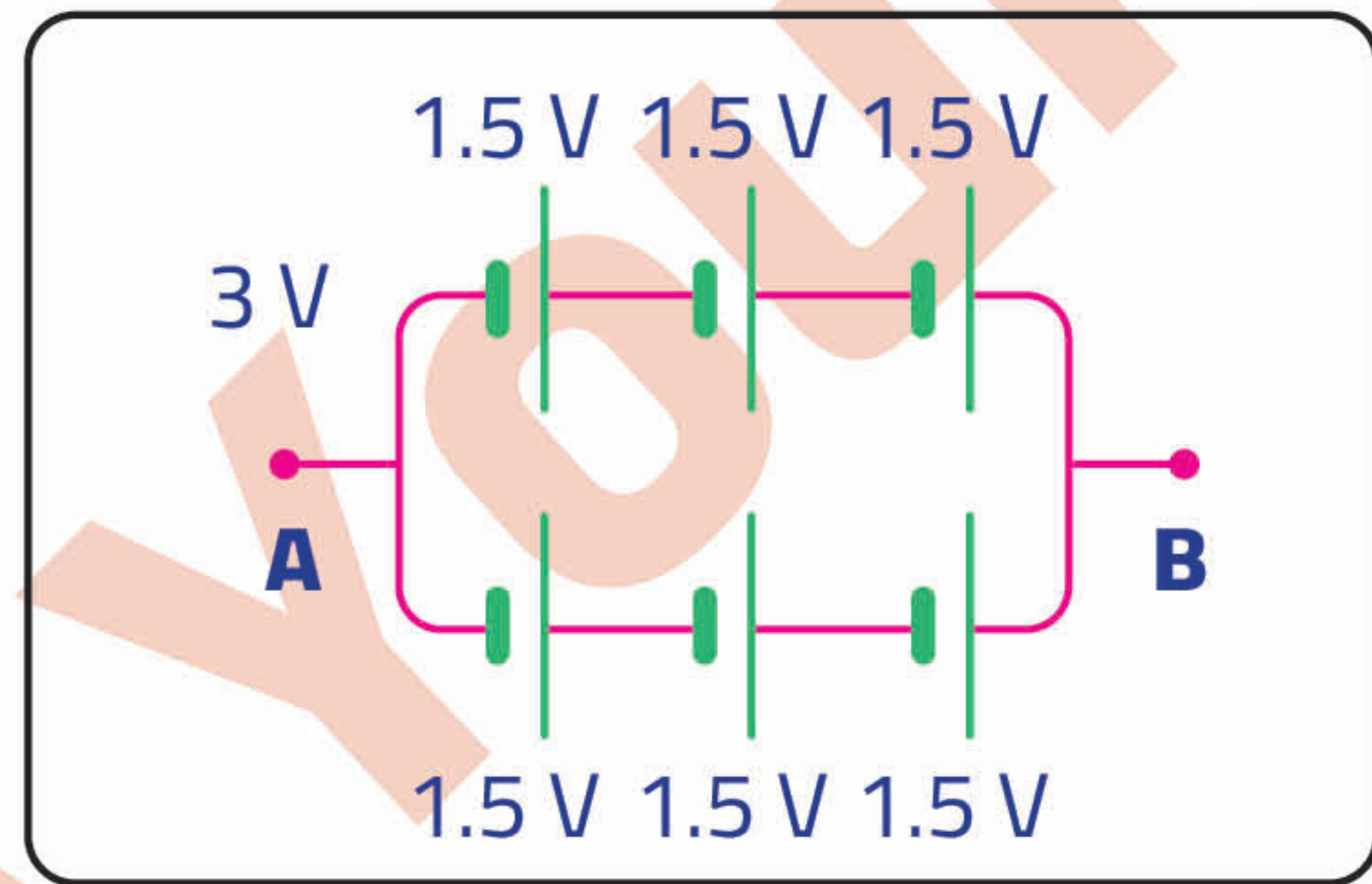
(2) In parallel.

Sol

- 2** Calculate the e.m.f. between the two terminals A and B of the two following circuits:



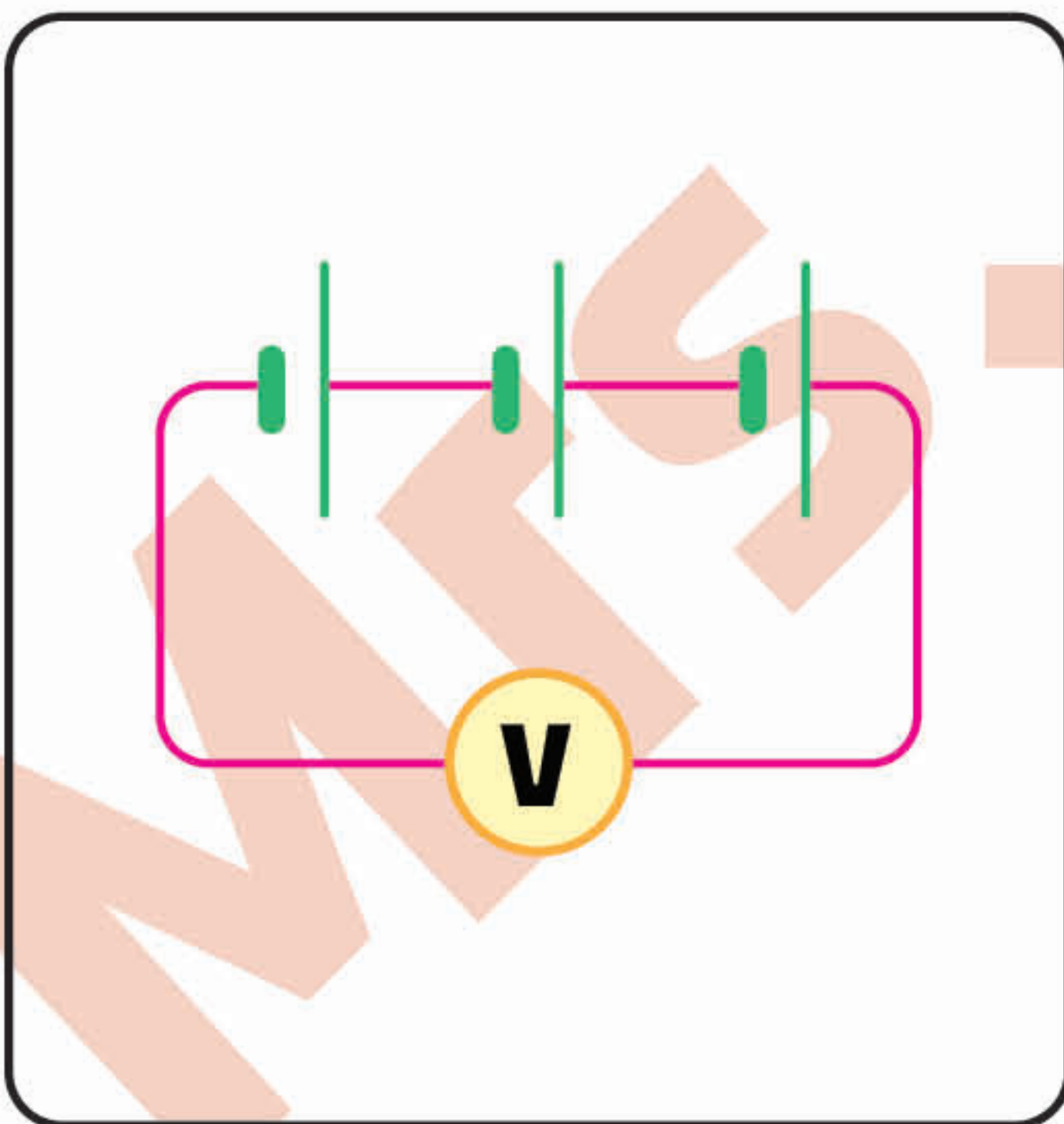
(1)



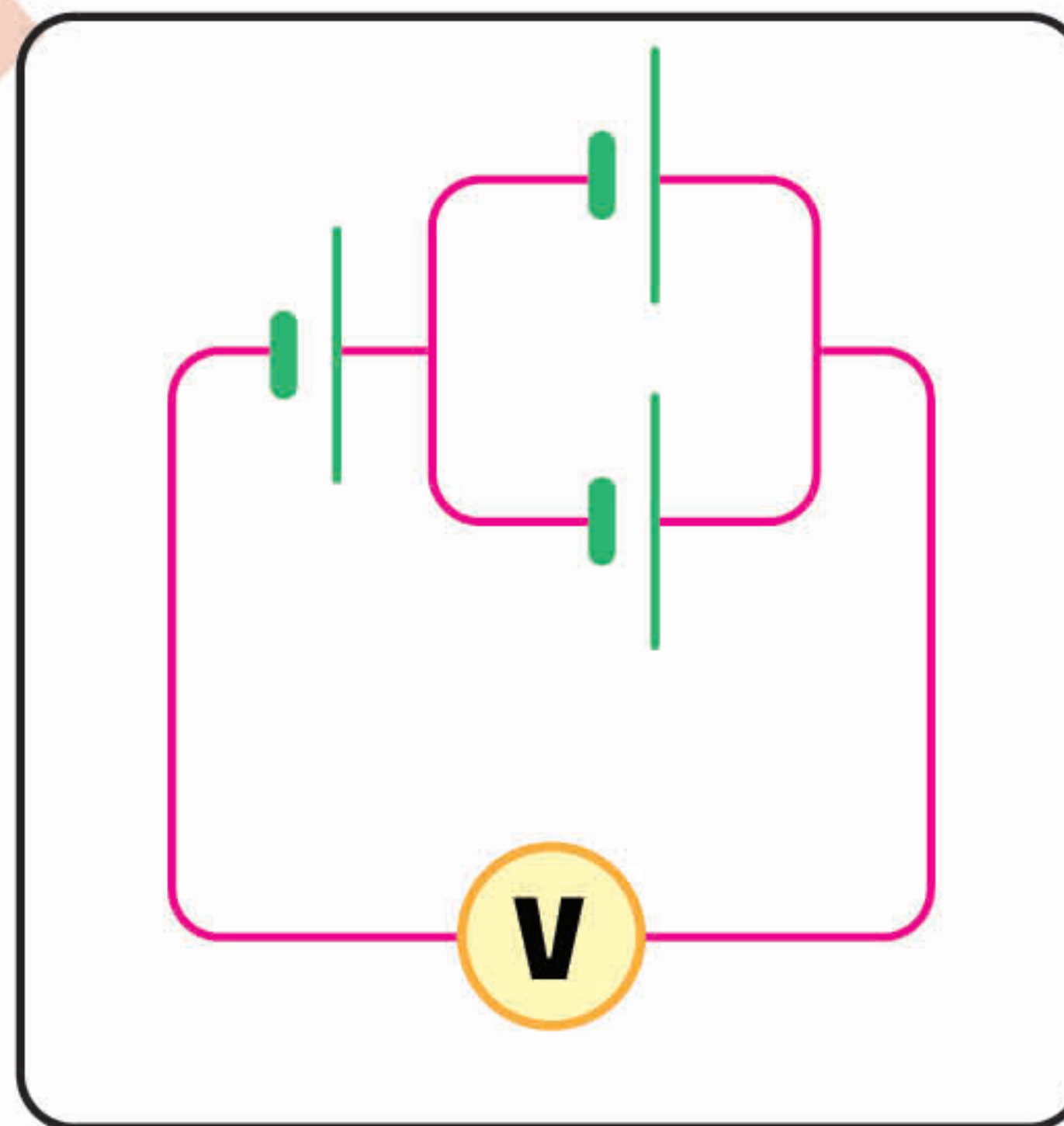
(2)

Sol

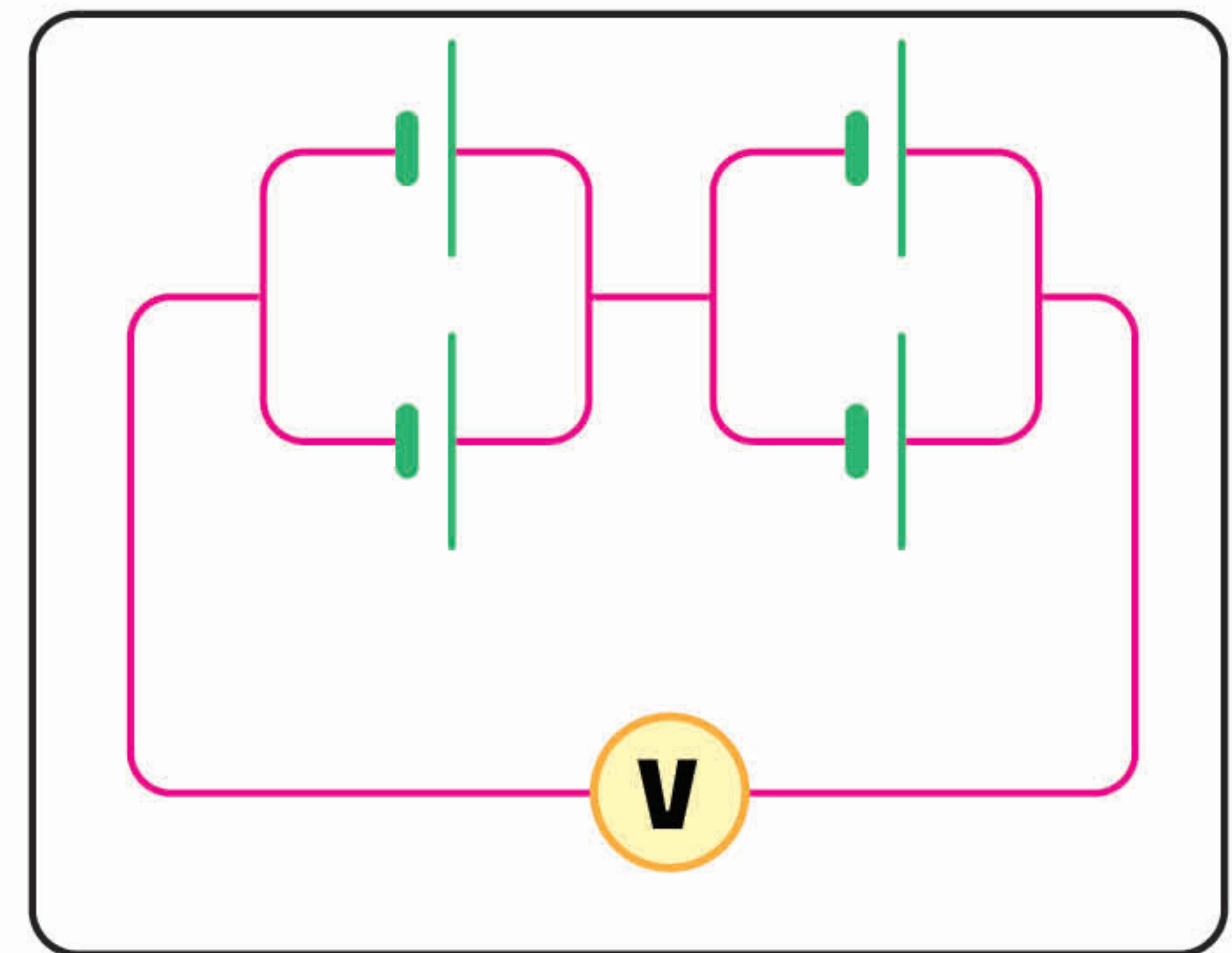
- 3** Mention the reading of the voltmeter in each of the following circuits. Knowing that e.m.f. of each dry cell is 1.5 volt.



(1)



(2)



(3)

Sol

- 4** If you have 4 similar dry cells, the e.m.f. of each cell is 1.5 volt. Show by drawing how to join them to get a new battery of e.m.f. = 3 volt [in three different ways].

Sol

- 5** If you have 3 dry cells, the e.m.f. of each cell is 3 volt. Show by drawing how to join them to get a new battery of:

(a) Highest e.m.f.

(b) e.m.f. = 6 volt.

(c) Lowest e.m.f.

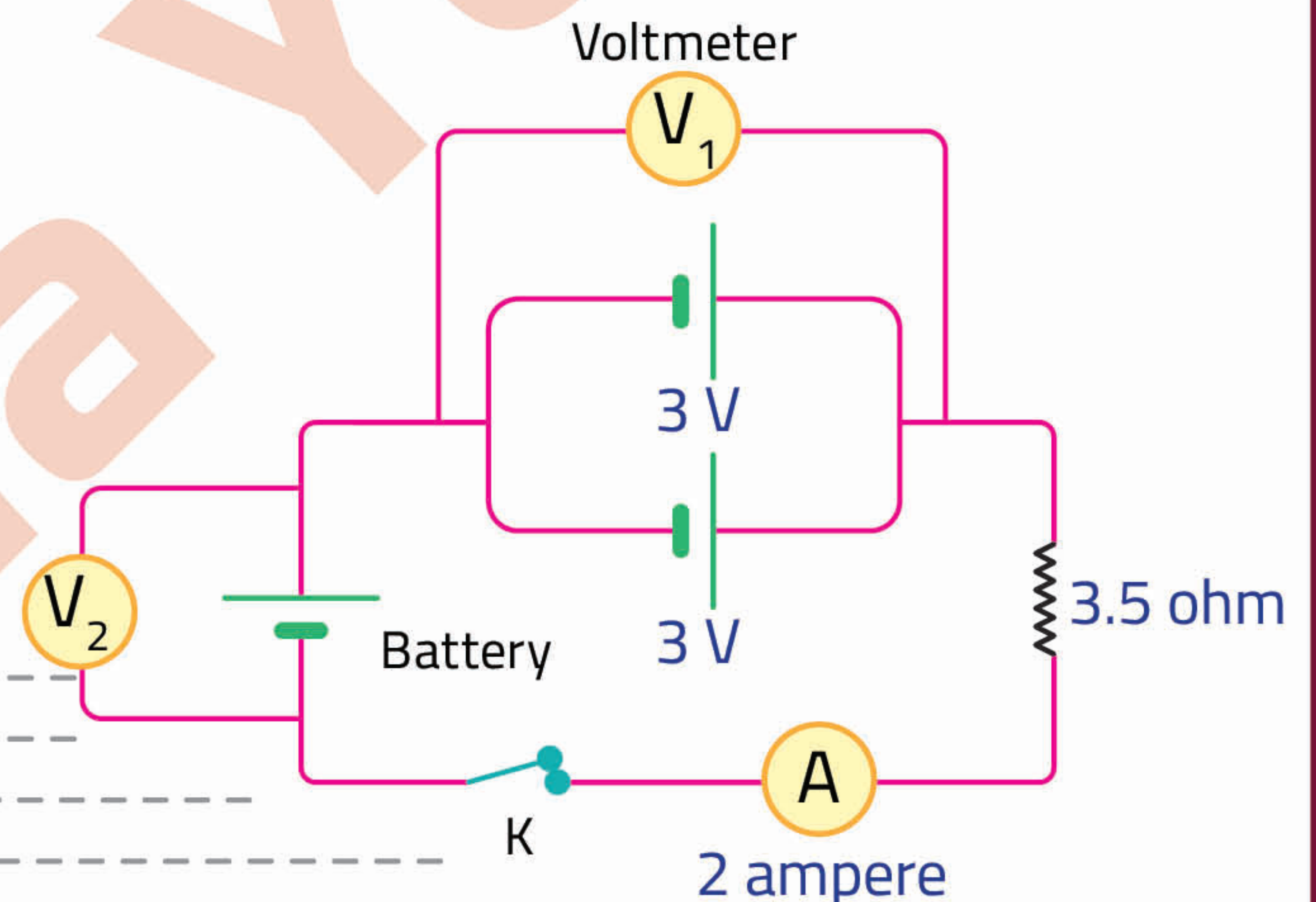
Sol

- 6** In the opposite electric circuit, if the key (K) is opened. Determine the e.m.f which is measured by:

(a) The voltmeter (V_1).

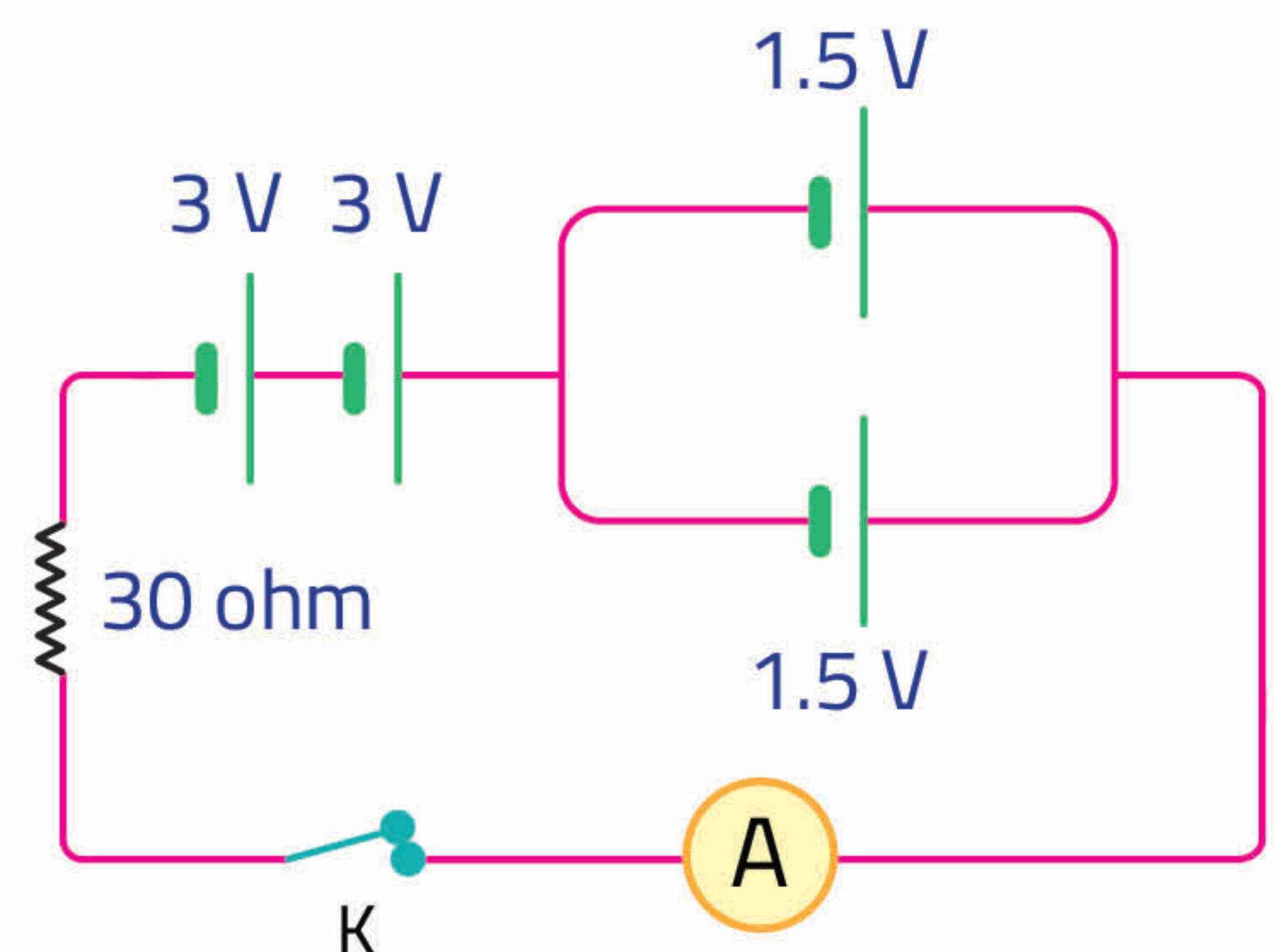
(b) The voltmeter (V_2).

Sol



- 7** Calculate the electric current intensity passing through the opposite electric circuit.

Sol



GIVE REASON

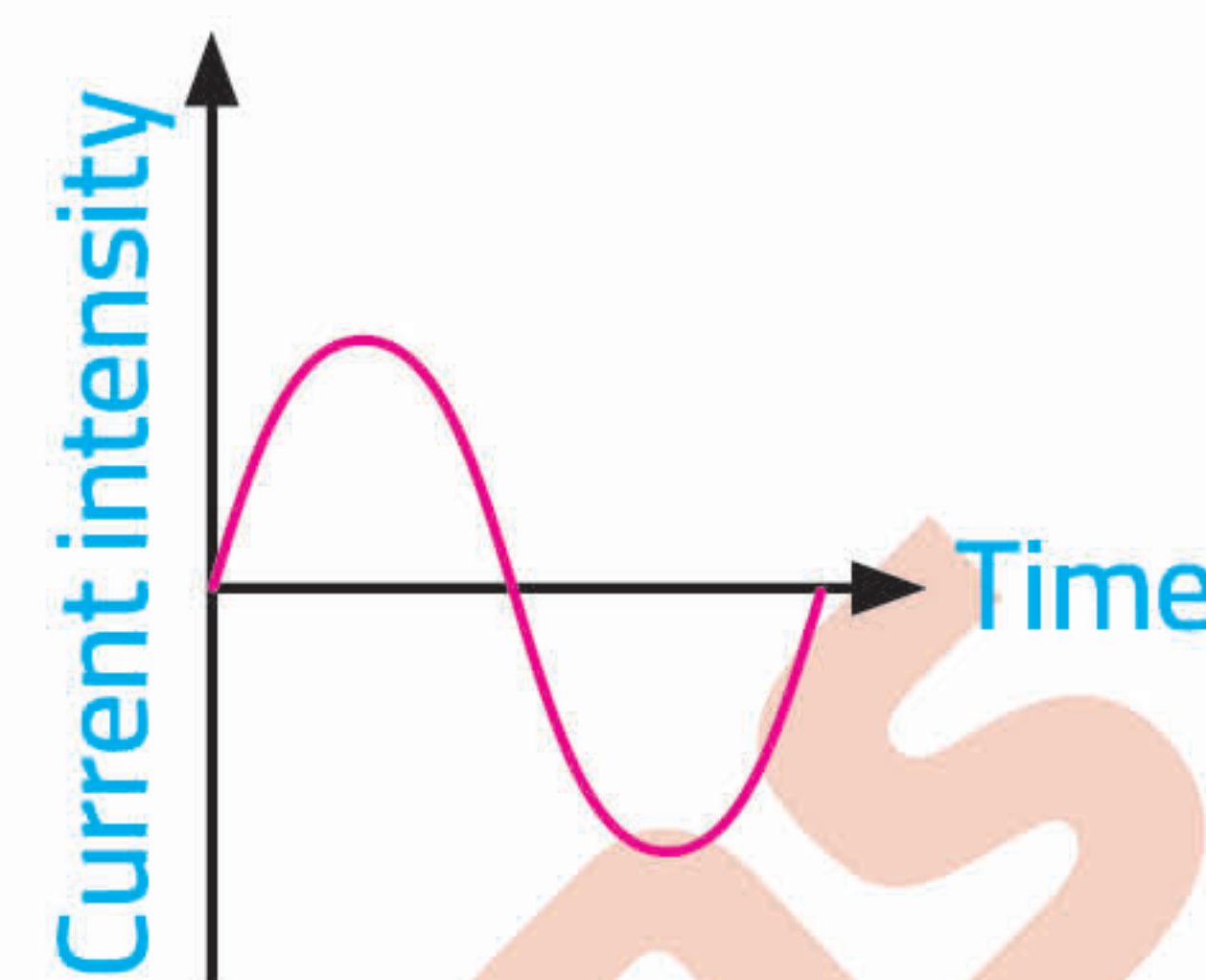
1 The opposite graph represents the alternating current.

Because it is variable in both direction and intensity.

2 The alternating current is preferred than the direct current.

Because:

1. It can be transferred for long distances through wires.
2. It can be changed into a direct current.



3 Electric current produced from electric generators is used in lighting and operating electric appliances.

Because it is an alternating current which is variable in both direction and intensity and it can be changed into a direct current.

4 Some cells are connected in the electric circuit in series.

To obtain a battery, the e.m.f of it is high.

4 Some cells are connected in the electric circuit in parallel.

To obtain a battery, the e.m.f of it is low.

5 The electromotive force of a battery whose cells are connected in series is greater than that one whose cells are connected in parallel.

Because the total e.m.f. for a group of cells connected in series is equal to the sum of the e.m.f. for these cells, while the total e.m.f. for a group of cells connecting in parallel is equal to the e.m.f. of one cell.

WHAT HAPPENS WHEN

1 A group of electric cells are connected in series (related to e.m.f.).

The total e.m.f. increases.

2 A group of similar electric cells are connected in parallel (related to e.m.f.).

The e.m.f. equals the e.m.f. of one cell.

درست قبل كذا
الحاجات دي



- Elements consist of **atoms**.
- Atoms consist a **nucleus** surrounded by **electrons**.
- **The mass of the atom is concentrated in the nucleus.**
- **Atom composition** is responsible for the physical and chemical properties of the element.
- **Chemical reactions** occur through outermost electrons.
- **Nuclear reactions** occur due to the change in the number of protons and neutrons inside nucleus.

**GIVE
REASON**

The mass of the atom is concentrated in the nucleus.

Because the mass of electrons is negligible compared with the mass of protons and neutrons in the nucleus.

Nuclear Energy

- ☢ **The nuclei of atoms of stable elements are coherent despite the presence of repulsion forces inside them.**

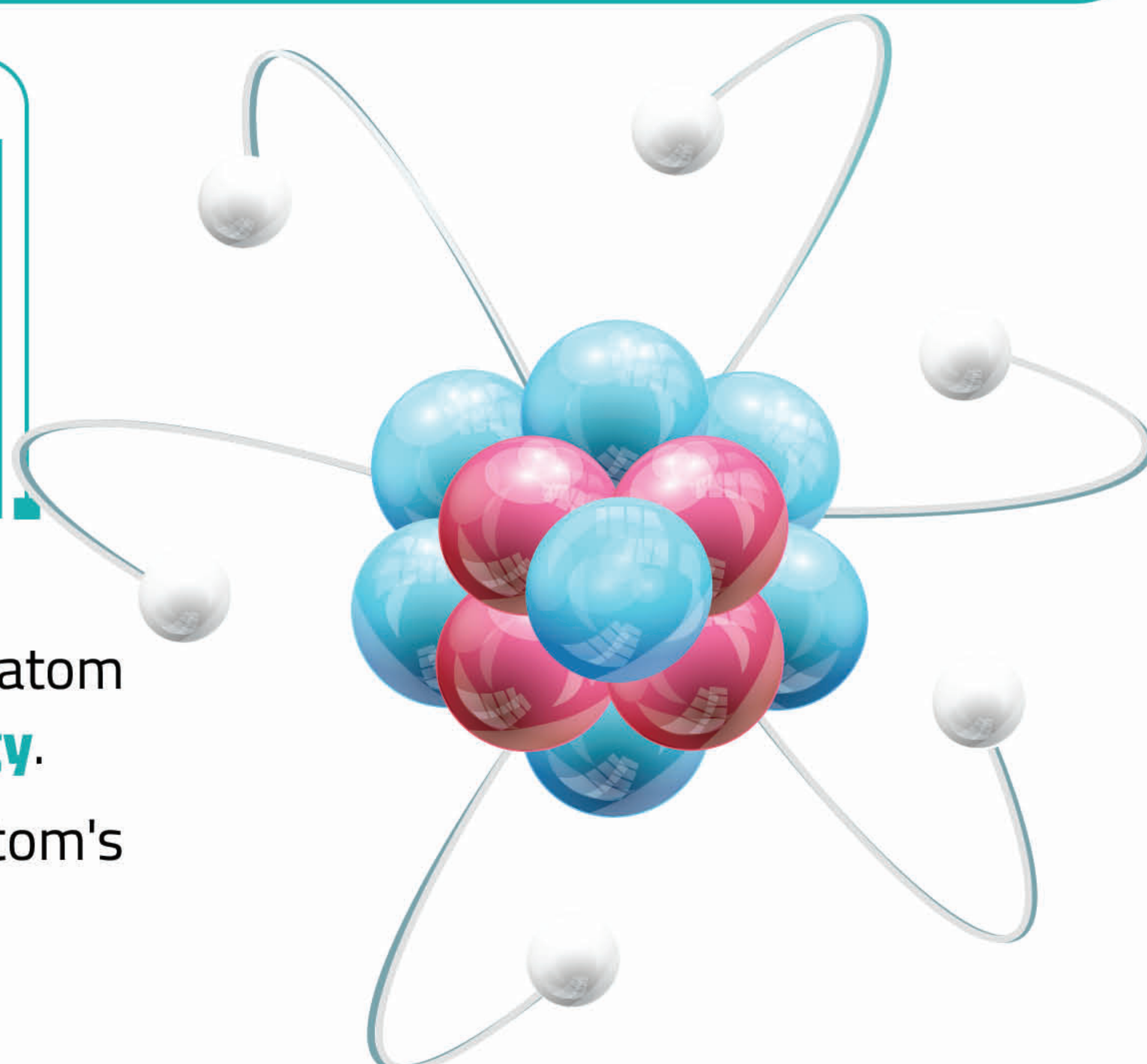
Since **forces** inside the nucleus acts on:

- binding the nucleus components together.
- overcoming the repulsion forces that are present between the positively charged protons and each other.

These forces are called the nuclear binding forces.

Nuclear binding forces

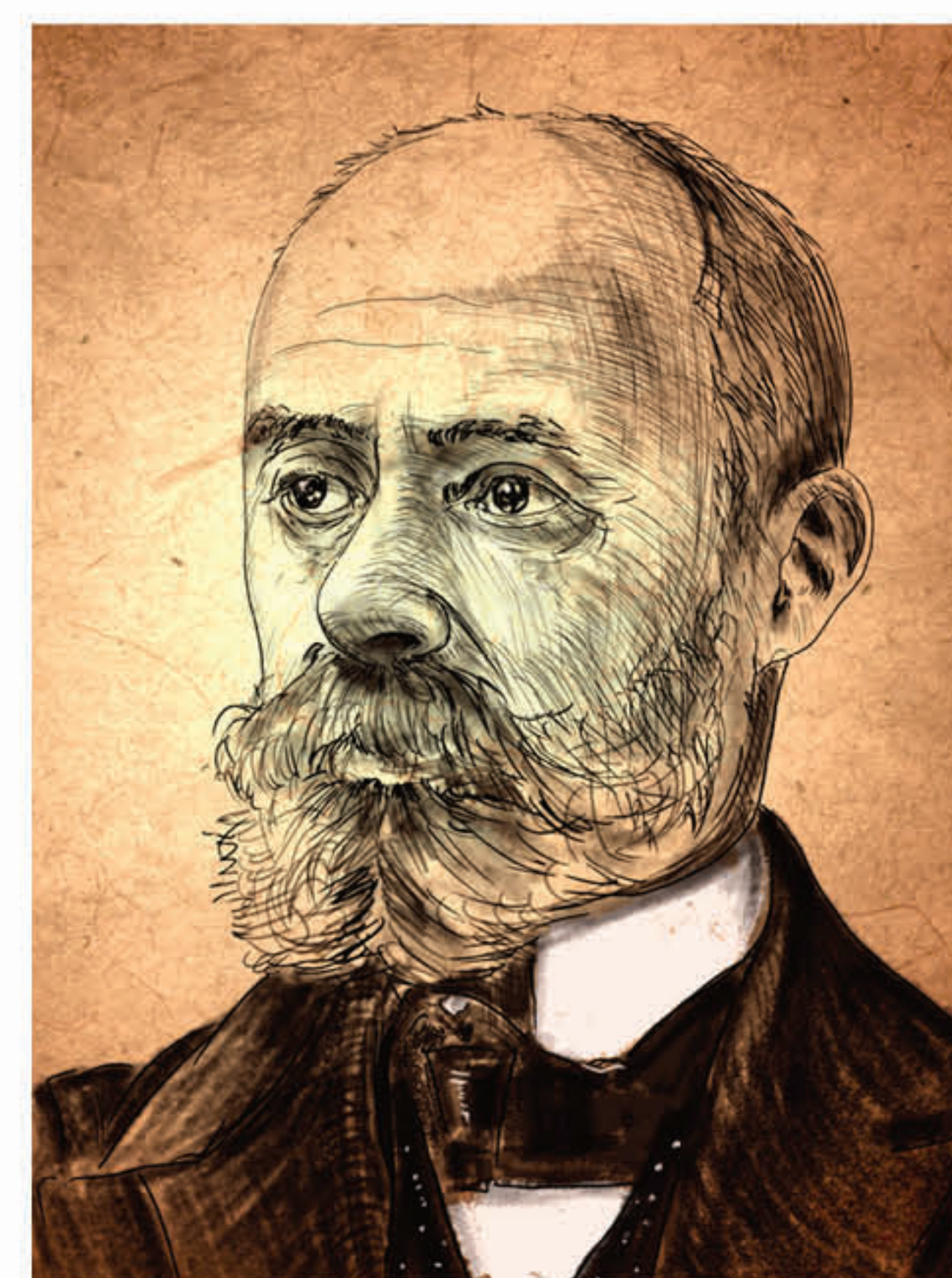
They are the forces that are necessary to bind the nucleus components together and overcome the repulsion forces that are present between the positively charged protons and each others.



- ☢ The nuclear binding energy provides the atom with a huge energy called **Nuclear energy**.
- ☢ The nuclear energy is stored in the atom's nucleus.

Radioactivity phenomenon

- 🔬 **Radioactivity** was discovered by a French scientist, **Henri Becquerel** in **1816**.
- 🔬 He discovered the emission of unseen rays from the uranium element, these rays have the ability to penetrate solid objects.
- 🔬 These elements are (**Radioactive elements**) and this phenomenon is named (**Radioactive phenomenon**).



Radioactive elements

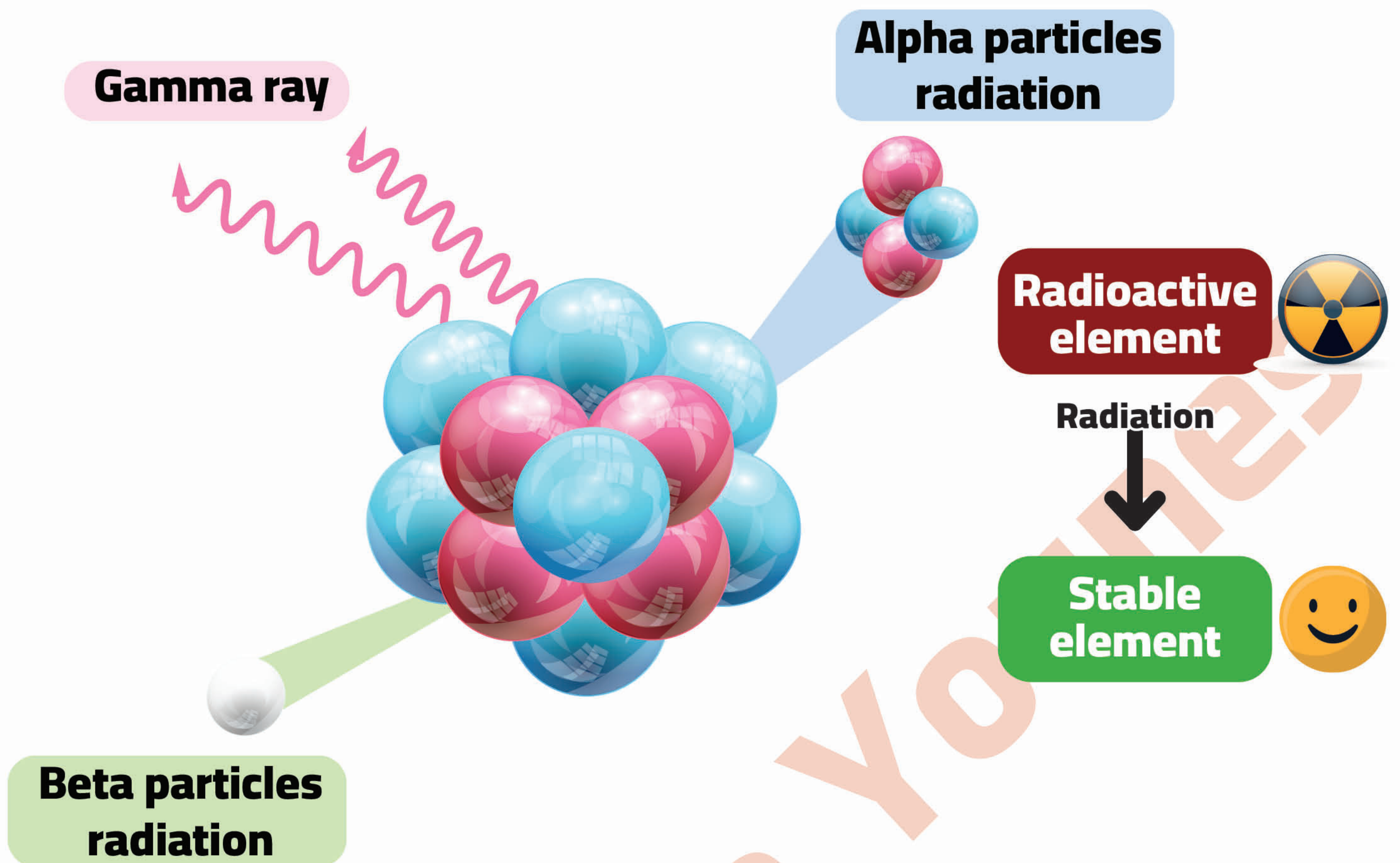
They are elements whose atoms' nuclei contain a number of neutrons more than the number required for its stability.



- 🔬 The atom's nuclei of radioactive elements emit invisible radiations (**Alpha particles, Beta particles, Gamma radiations**) automatically.
To get rid of the excess energy to achieve a more stable composition.
- 🔬 This process is known as **Radioactivity phenomenon (Natural radioactivity)**.

Radioactivity phenomenon

It is the spontaneous decay of the atoms' nuclei of some radioactive elements that are present in nature in an attempt to achieve a more stable composition.



GIVE REASON

1 Some elements are called radioactive elements.

Because they release unseen rays spontaneously as a result of their atoms' nuclei containing neutrons more than the required number for their stabilization.

2 Uranium is one of the radioactive elements.

Because the nucleus of its atom contains a number of neutrons more than the number required for its stability which causes the presence of excess energy emitted in a form of invisible (unseen) radiation.

WHAT HAPPENS WHEN

- **Some of the atoms nuclei containing number of neutrons more than the number required for its stability.**
- **The number of neutrons in the atom of the nucleus of an element increases more than the number required for its stability.**

Its energy increases, so it emits unseen (invisible) radiations to reach a more stable composition.

Artificial Radioactivity

☢ There is another type of radioactivity which is known as **artificial radioactivity** which is the radiation or nuclear energy that is neither released during nuclear reaction, which:

Can be controlled

Like these which are done in **nuclear reactors** and are used in **safe uses**.



Cannot be controlled

Like these which are done in **nuclear bombs** and are used in **military uses**.

Artificial radioactivity

It is the radiation or nuclear energy that is either released during nuclear reactions or nuclear bombs.

GIVE REASON

Radioactivity has natural sources and also artificial.

Because there are natural radioactivity which is produced from the radioactive elements present in the nature and cosmic radiation that comes from outer space, and artificial radioactivity which is produced from nuclear reactions and nuclear bombs.

The peaceful uses of nuclear energy

1 Medical Field

To diagnose and treat diseases like cancer.



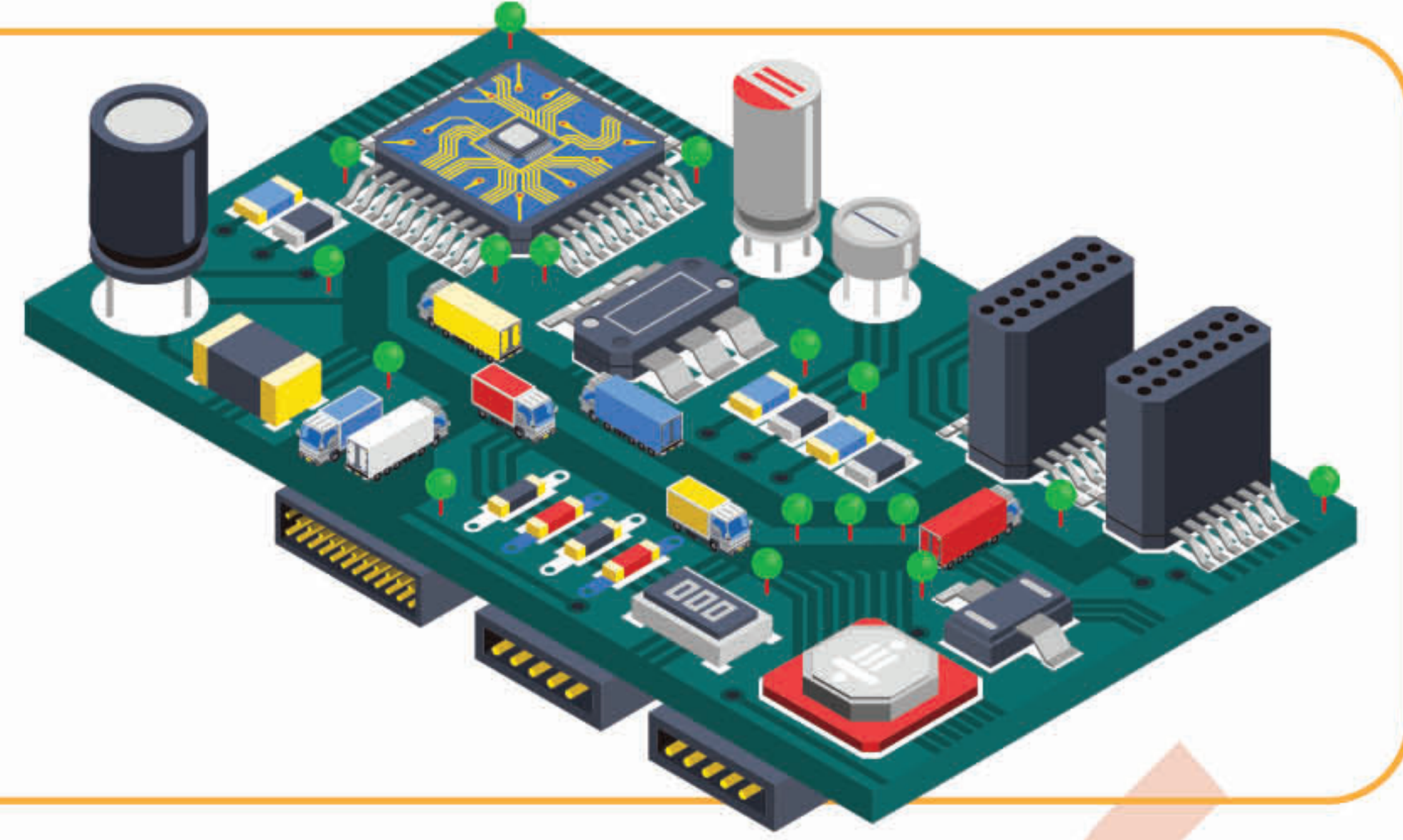
2 Agricultural Field

To eliminate pests and to improve some plant races.



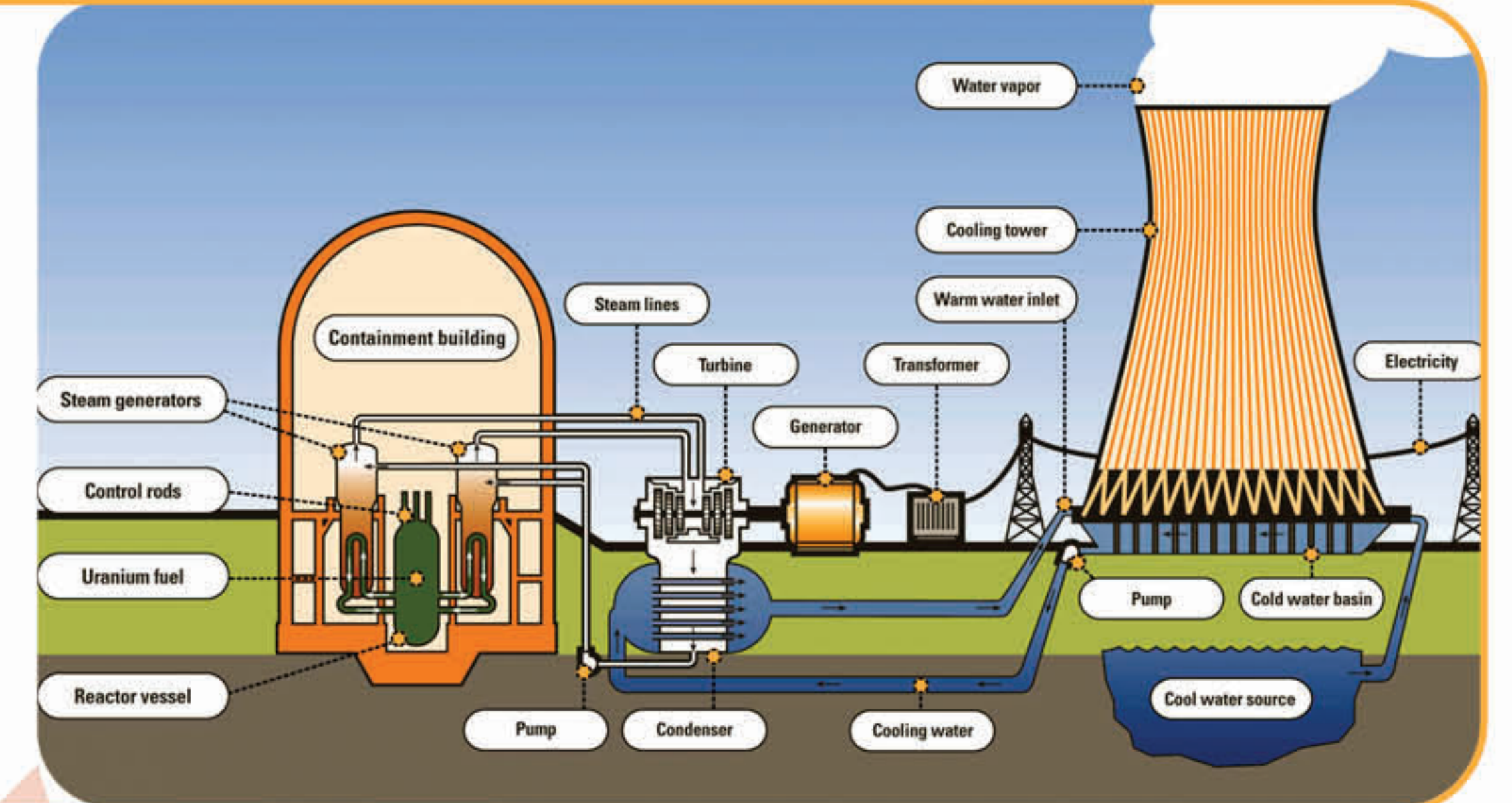
3 Industrial Field

- To convert sand to silicon sheets which is used in manufacturing computer processors and programmed electric circuits that are used in electric appliances.
- To discover defects in the manufactured products.



4 Electricity Generation Field

The nuclear energy is used to heat water to produce steam. This steam is used to operate turbines to **generate electricity**.



5 Space Exploration Field

The radioactive materials are used as a nuclear fuel for rockets that fly in space.



6 Drilling Field

For drilling of petroleum and underground water.



Radiation Pollution

Radiation pollution

It is the increase of the amount of radiation in the environment.



Sources of radiation pollution:

Natural sources

They are represented by:

1. Natural radioactive materials found on Earth's surface (radioactive elements).
2. Cosmic radiation that comes from the outer space.



Artificial sources

They take place due to:

1. The explosion of nuclear bombs that some countries do as experiments from time to time.
2. The nuclear reactors.

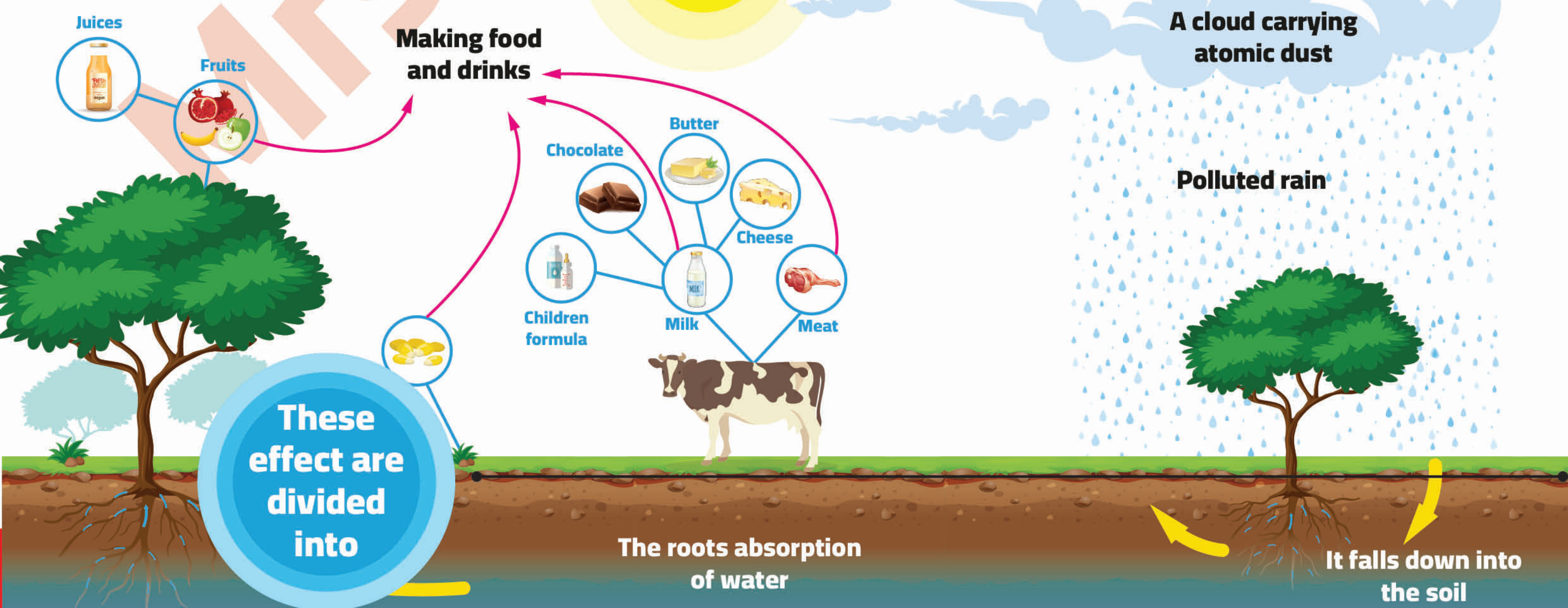
Chernobyl explosion

Time It occurs in 26th of April 1986.

Reason It occurs as a result of an error in operation.

Result

- The melting of reactor core led to nuclear explosion and the release of many radioactive elements.
- These elements formed an atomic cloud.
- This polluted cloud was carried by the wind to many countries in Europe.
- When rain fell (in May), it carried radioactive elements to Earth's surface.
- The plants and soil were polluted by the fallen radioactive isotopes (elements).
- Cow and sheep ate these plants. Their milk products and meat were polluted by radiation.



Isotopes

They are atoms of the same element that contain the same number of protons and different number of neutrons.

-  The elements that were found in the polluted food after the Chernobyl accident are iodine and cesium isotopes that are produced from the decay of the nuclear fuel (Uranium-235) when absorbing the neutrons.

GIVE REASON

1 Radiation pollution occurs.

Due to the increase of the amount of radiation in the environment.

2 Explosion of the Russian Chernobyl reactor.

Due to an error in operation.

3 After the Chernobyl accident, radioactive isotopes were found in the food products.

Due to the transfer of polluted atomic cloud by the wind, then rain fell and radioactive isotopes transferred to the soil and polluted plants and animals.

4 The radiation pollution may occurs in areas at which a nuclear explosion is not occurred.

Because the radiation pollution may be transferred by the dry fallen by wind or by falling of rains to Earth's surface.

Radiation effects on the human body

-  The radiation affects on the human body differ in the amount of radiation and duration of the exposure to the radiation.
-  These effects can be divided into two groups:

First The effects due to exposure to a large dosage of radiation for a short time (one day or less)

-  This will lead to the damage of:
- Bone marrow (first affected) which is responsible for the formation of blood cells, so its damage will lead to the decrease in the number of red blood cells in the human body.
 - Spleen.
 - Digestive system.
 - Central nervous system.

Second

The effects due to exposure to a small dosage of radiation for a long time (months or years)

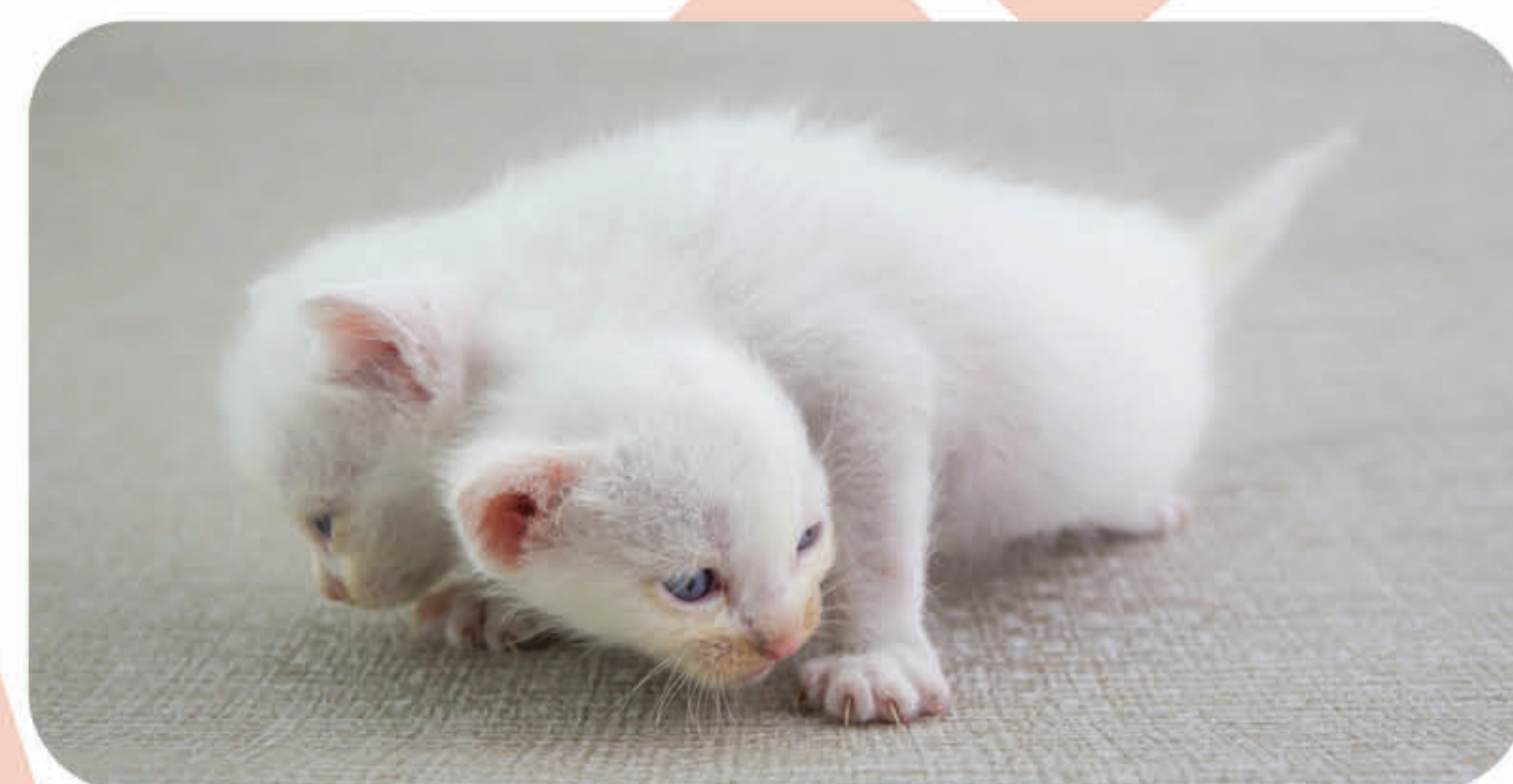
A Physical effects

- They are changes that appear on a living being, as a result of exposure of radiation like **skin cancer**.



B Genetic effects

- They are changes in the sex chromosomes composition which result in abnormal birth.



C Cellular effects

- They are the changes in the cells composition which lead to destroy the cells. For instance, if the chemical composition of the hemoglobin changes, it becomes incapable of carrying oxygen.

Measuring the radiation

- The measuring unit of absorbed radiation is the **Sievert (Sv)**.
- The maximum safe dose of nuclear radiation should not exceed **20 milli Sievert** for a worker with radiation a **year**. Regular people should not exceed **1 milli Sievert**.

Means of protection from radiation pollution

- Not to be exposed to the maximum safe dose of nuclear radiation (5 Rem in one day).
- The workers with radioactive elements in the labs and hospitals should wear radiation protective gloves, clothes and masks.
- Follow the following precautions, while dealing with radioactive wastes:
 - Radioactive wastes should be away from underground water path, so it will not be polluted.
 - The area chosen for storing radioactive wastes should be a steady one (not exposed to earthquakes and volcanoes) and away from animals that live in caves. To prevent the spreading of the radioactive wastes in the surrounding environment by the effect of earthquakes or volcanoes.

- ④ Nuclear wastes of weak and medium radiation are surrounded by a cement layer or rocks and are placed deep inside the ground, while the nuclear wastes of strong radiation are cooled using water, then they are deeply buried in the ground away from inhabited areas (so as not to by injure the living beings in seas and lakes).
- ⑤ Issue laws for nuclear stations to cool the hot water before throwing it in seas and lakes.

GIVE REASON

1 The exposure to a large radiation dosage for a short time leads to decrease in the number of red blood cells.

Due to the damage of bone marrow which is responsible for the formation of red blood cells.

2 Radiation has genetic effects.

Because radiation causes changes in the sex chromosomes composition for living organisms.

3 Workers with radioactive elements must wear radiation protective gloves, clothes and masks.

To protect themselves from radiation pollution.

4 The radioactive wastes should be buried away from underground water's path.

To not pollute water.

5 The areas chosen for storing radioactive wastes should be steady.

To prevent the spread of radiation to other areas.

WHAT HAPPENS WHEN

1 A man is exposed to large dosage of radiation for a short time.

This may lead to the damage of:

- Bone marrow.
- Spleen.
- Digestive system.
- Central nervous system.

2 The red blood cells decrease in the human body.

This will lead to:

- Feeling of being sick.
- Sore throat accompanied by nausea, vertigo and diarrhea.

3 A man is exposed for a small dosage of radiation for a long time.

This will lead to:

- Physical effects.
- Genetic effects.
- Cellular effects.

The Main Principles of Heredity

Part 1

Hereditary traits

Hereditary traits

They are the traits that **are transmitted** from one generation to another.

Acquired traits

Acquired traits

They are the traits that **aren't transmitted** from one generation to another.

Examples

- 1 Hair color.
- 2 Skin color.
- 3 Number of fingers.
- 4 The blood groups.

- 1 Skill of playing football.
- 2 Learning of swimming.
- 3 Speaking in many languages.
- 4 Learning of walking in children.

Genetics

It is a science that researches the transmission of the hereditary traits from one generation to another by studying the similarities and differences between the parents and the offspring.

GIVE REASON

- 1 **Learn to walk in children is not considered a genetic trait.**

Because it is acquired trait that can't be transmitted from a generation to another.

- 2 **The skill of playing basketball isn't hereditary trait.**

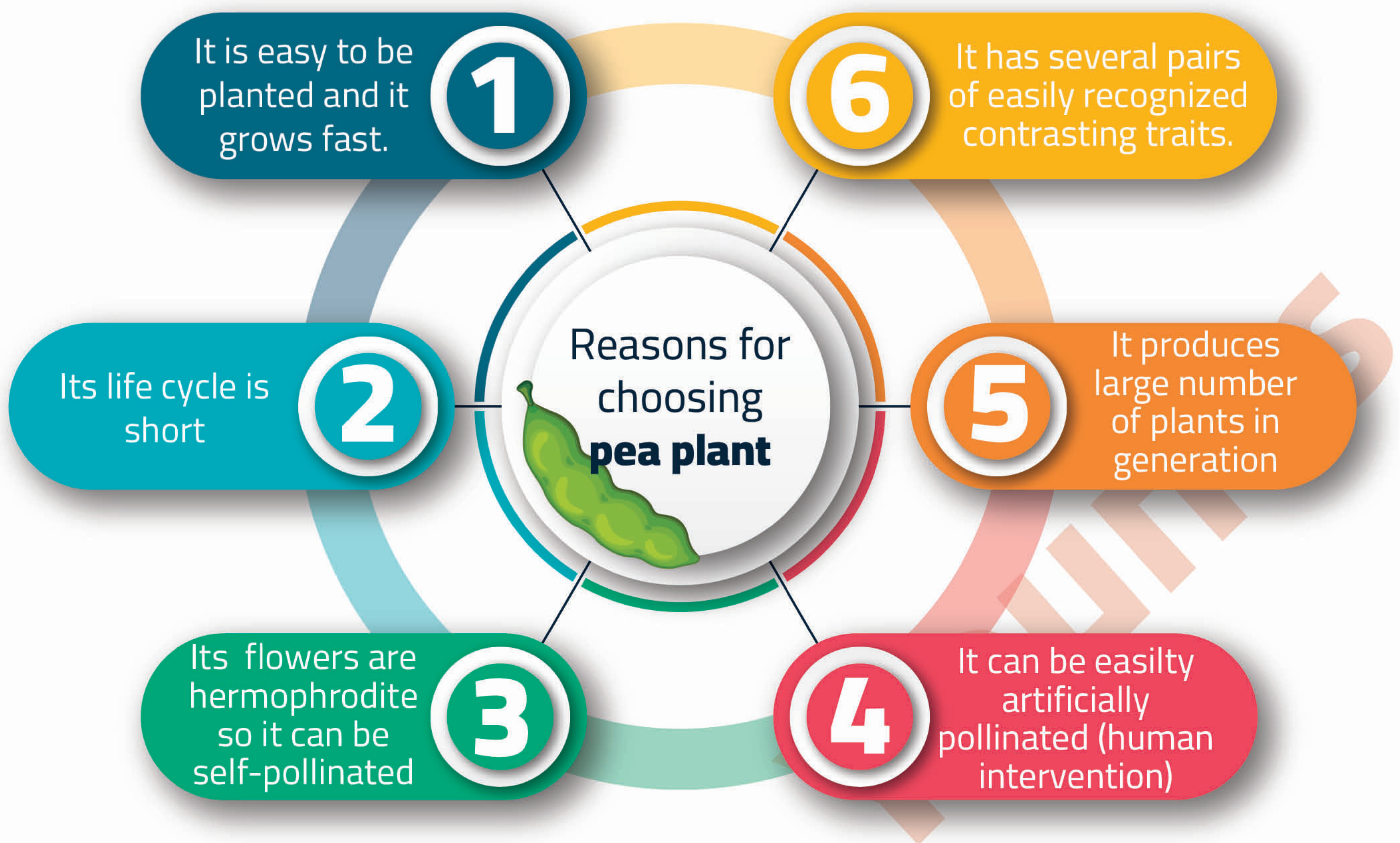
Because it is acquired trait that can't be transmitted from a generation to another.

Mendel is the founder of heredity

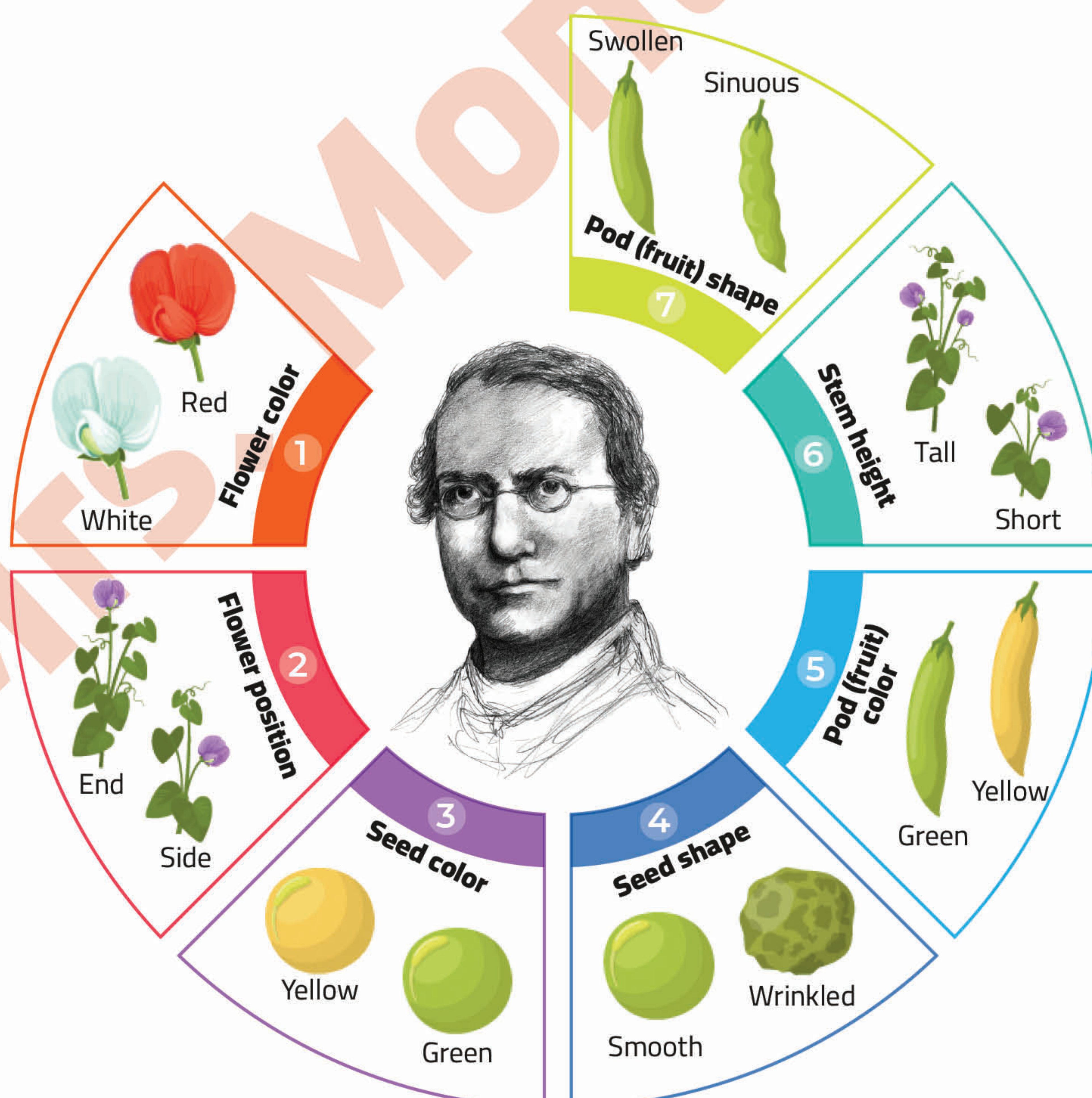
The scientist Gregor Mendel was the first founder of heredity.

Because the scientific studies of heredity started with Mendel's experiments on pea plant and according to the results reached by Mendel, scientists of heredity have gathered a lot of information about how the hereditary traits are transmitted from one generation to another.

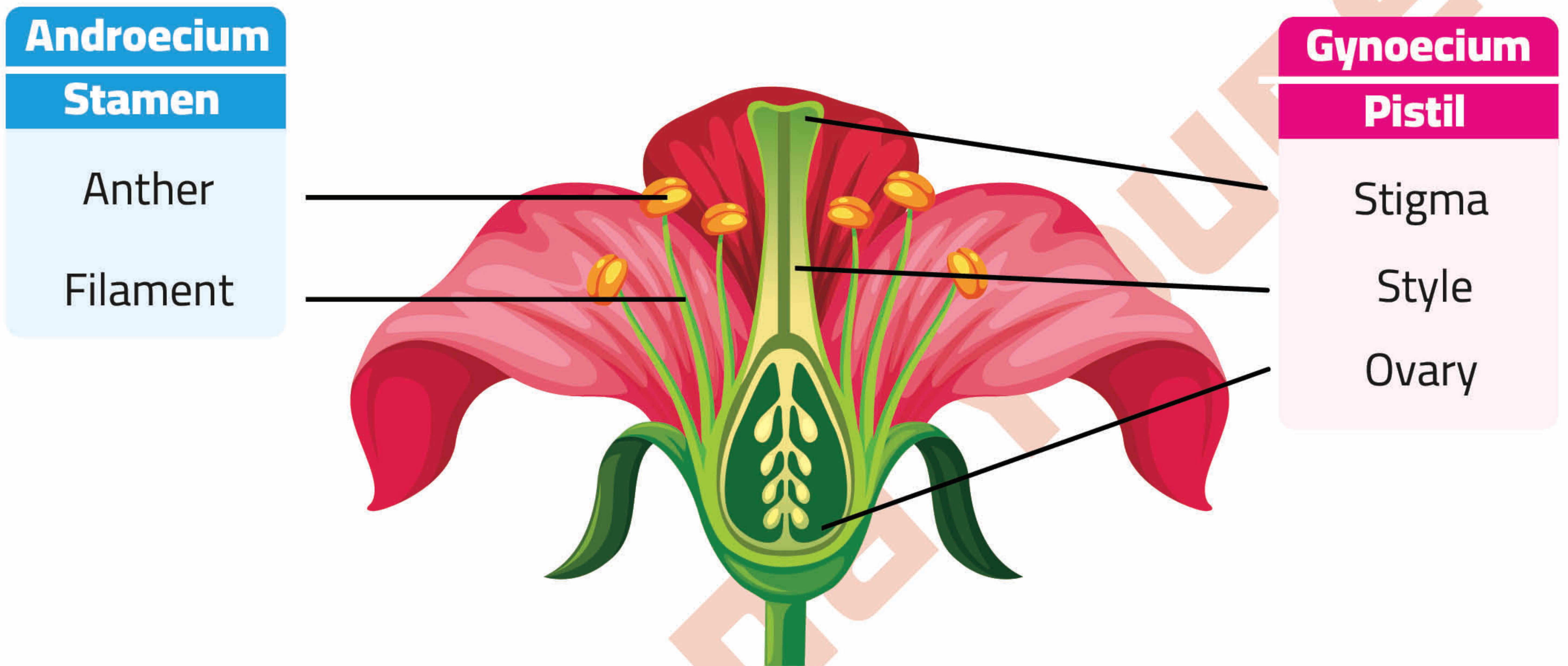




★ Despite the numerous different traits of pea plant, **Mendel** chose **seven** main traits to conduct his experiments which are shown in the following figure:



درست قبل كذا الحاجات دي



Hermaphrodite flower

It is the flowers that carries the male and female organs together.

Self-pollination

It is a process of transferring of pollen grains from the anthers of a flower to the stigmas of the same flower or to another flower in the same plant.

Mixed-pollination

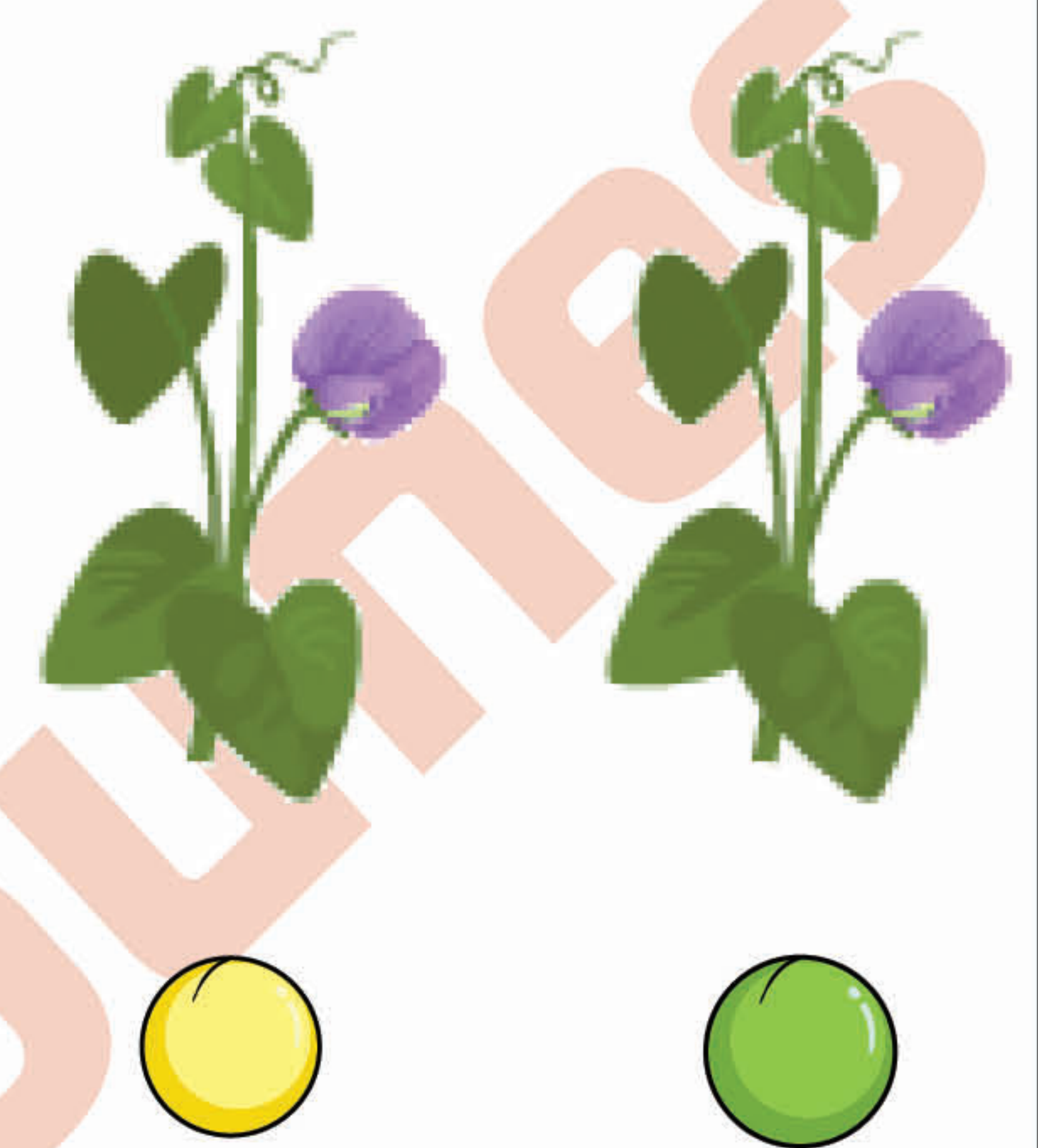
It is a process of transferring of pollen grains from the anthers of a flower to the stigmas of another flower in another plant of the same kind.

Mendel's experiments in heredity

First Study the inheritance of one pair of contrasting traits

Mendel's experiment to study the inheritance of the seed color trait of pea plant

- 1 Mendel chose a pea plant that produces **yellow** seeds and other pea plant that produces **green** seeds, then he made **self-pollination** for these plants for several generations. GIVE REASON
To be sure of the purity of this trait.



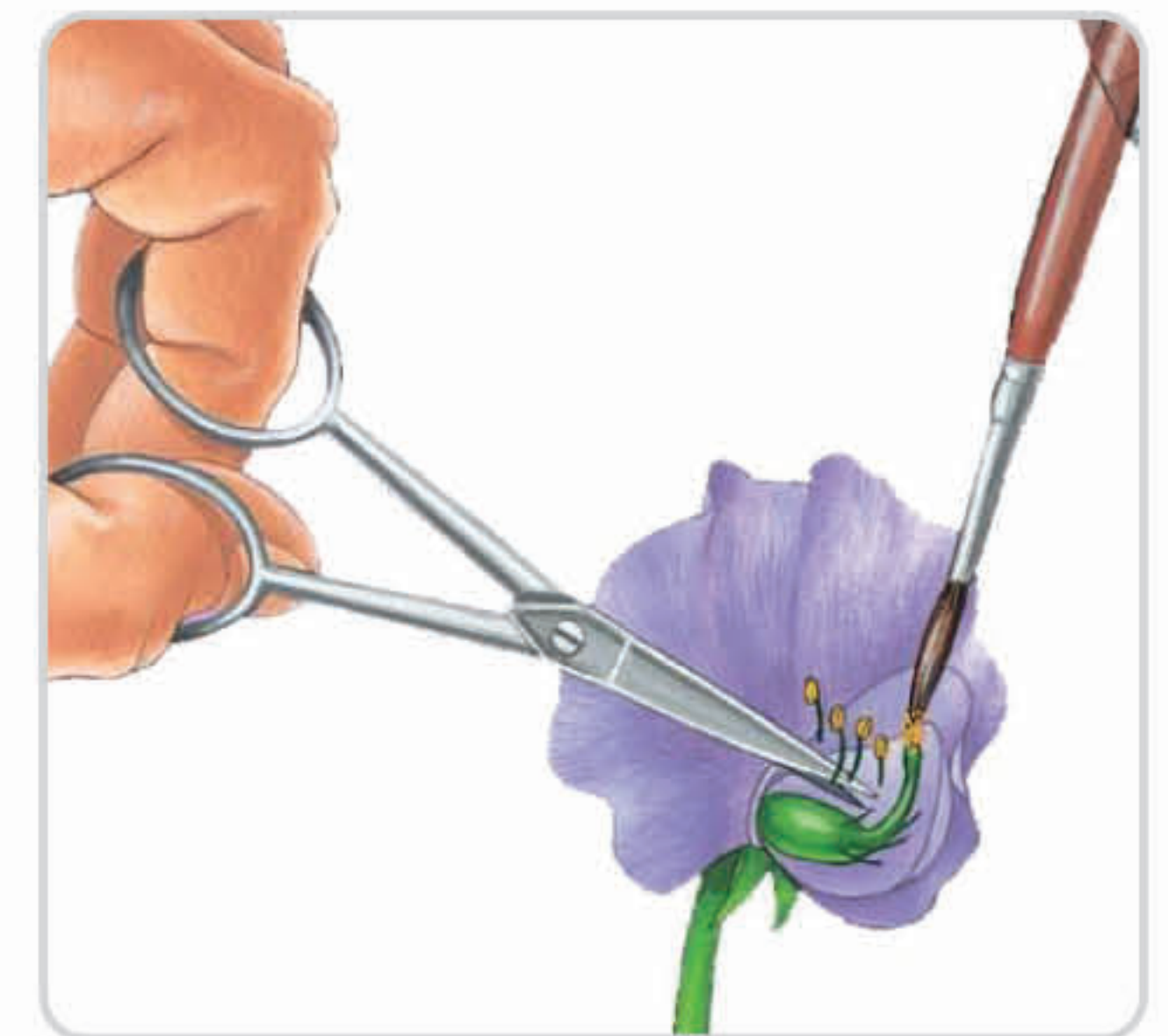
He observed that:

The plants that have **yellow** seeds produce plants with **yellow** seeds, a generation after generation, and also the plants that have **green** seeds produce plants with **green** seeds.

He concluded that:

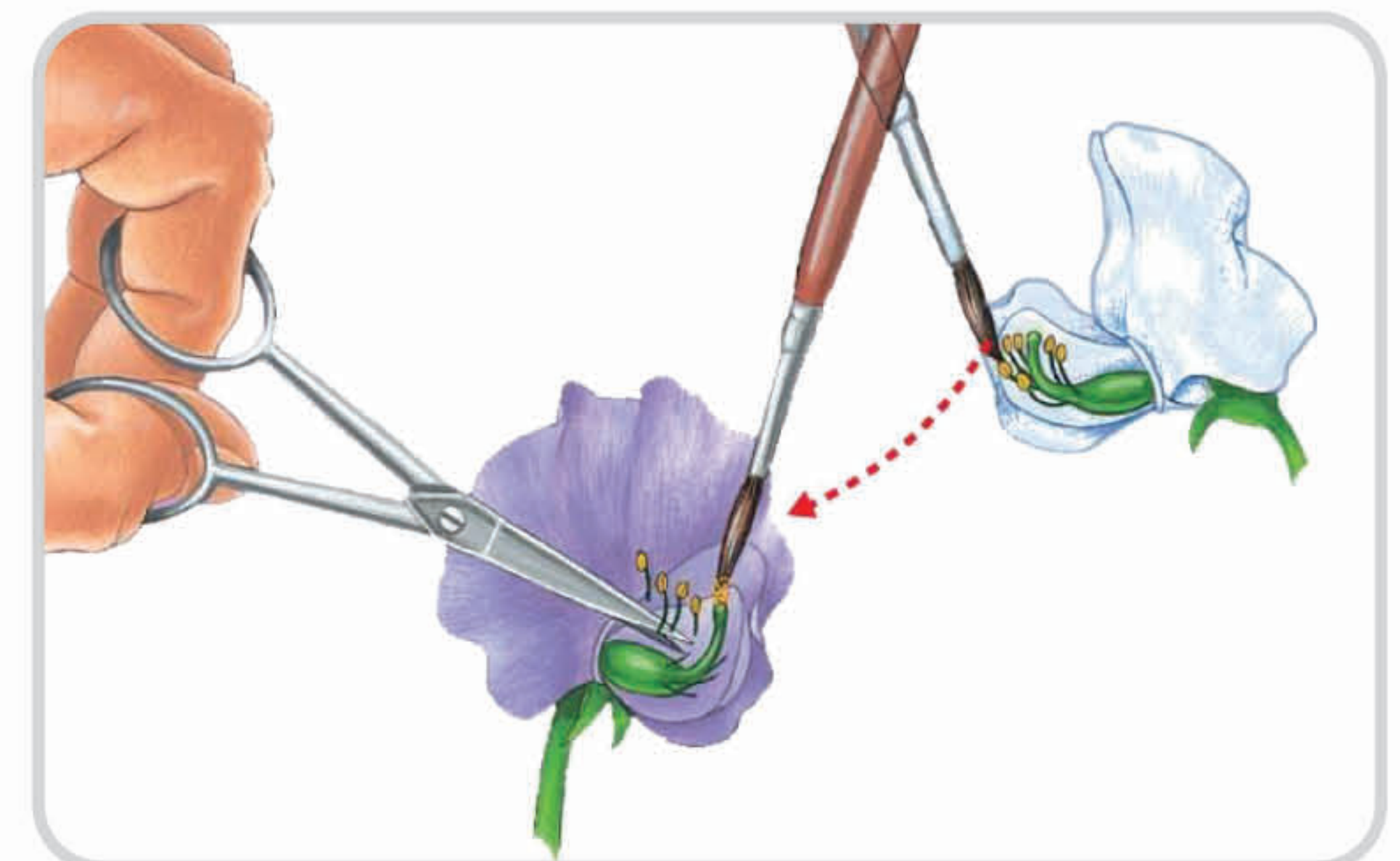
The color of the seed is pure in the plants that he had planted.

- 2 Mendel planted the seeds (pure **yellow** and pure **green**), and when they produce plants (parents) carrying flowers, he removed the stamens of some of these flowers before the anther becomes mature. GIVE REASON
To insure that the plant doesn't self-pollinate.



3 ★ Mendel made cross-pollination as follows:

1. By transferring the pollen grain from the anthers of plants' flowers that produce **green** seeds to the stigmas of plants' flowers which removed their stamens and produce **yellow** seeds.
2. By transferring the pollen grain from the anthers of plants' flowers that produce **yellow** seeds to the stigmas of plants' flowers which removed their stamens and produce **green** seeds.



- ★ Then, he covered the stigmas of the pistils after pollination. GIVE REASON
To prevent cross-pollination again.

- ★ Then, he planted the produced seeds.

He observed that:

All the produced plants (first generation) have **yellow** seeds (100%) and the **green** seeds trait disappeared completely in the individuals of the first generation.

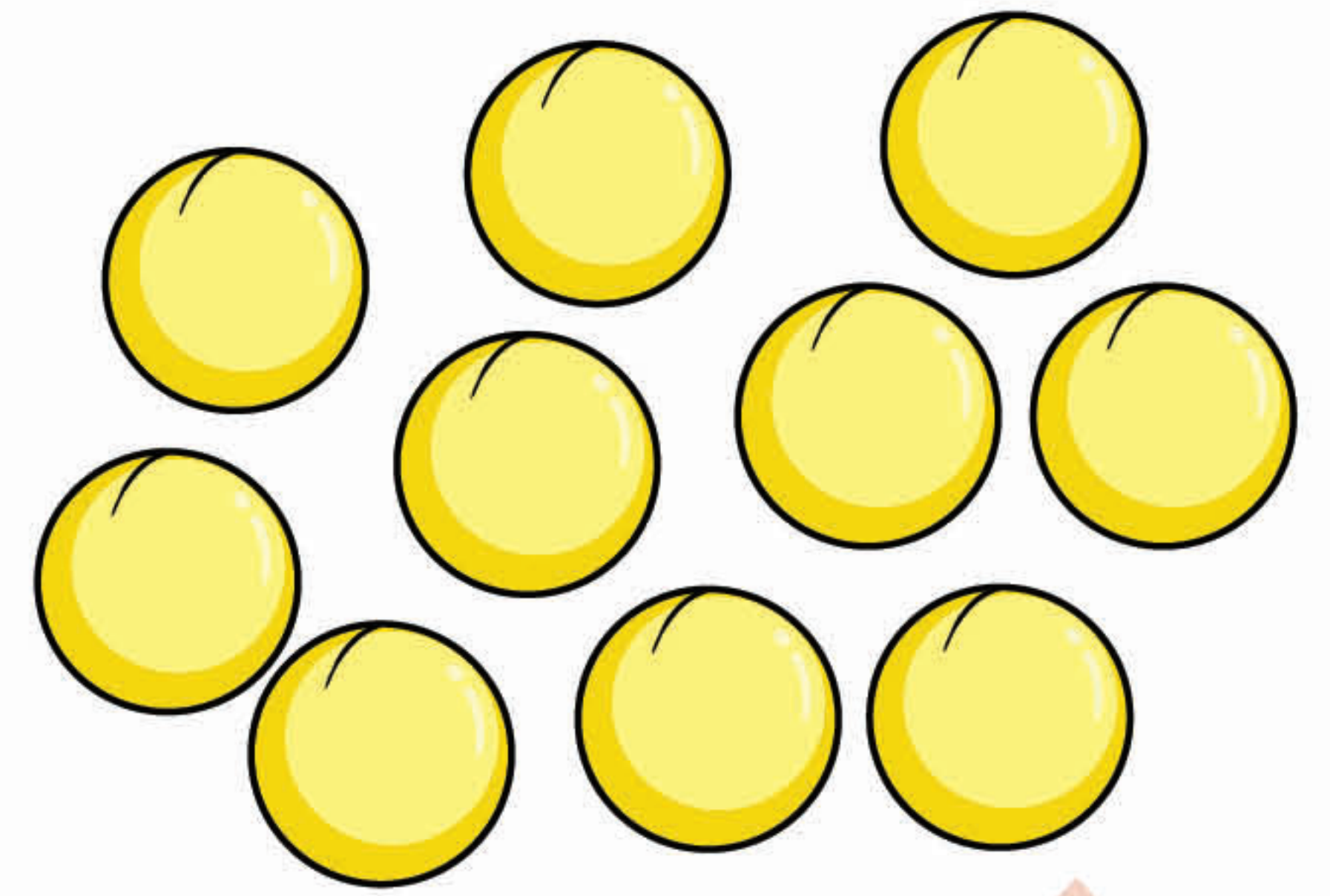
So, Mendel called:

- ★ The **yellow** color of seeds is a dominant trait. GIVE REASON

Because it dominates over the green color trait and appears in the first generation at a percentage of 100%.

- ★ The **green** color of seeds is a recessive trait. GIVE REASON

Because it disappears completely in the individuals of the first generation.



First generation
100% yellow seeds

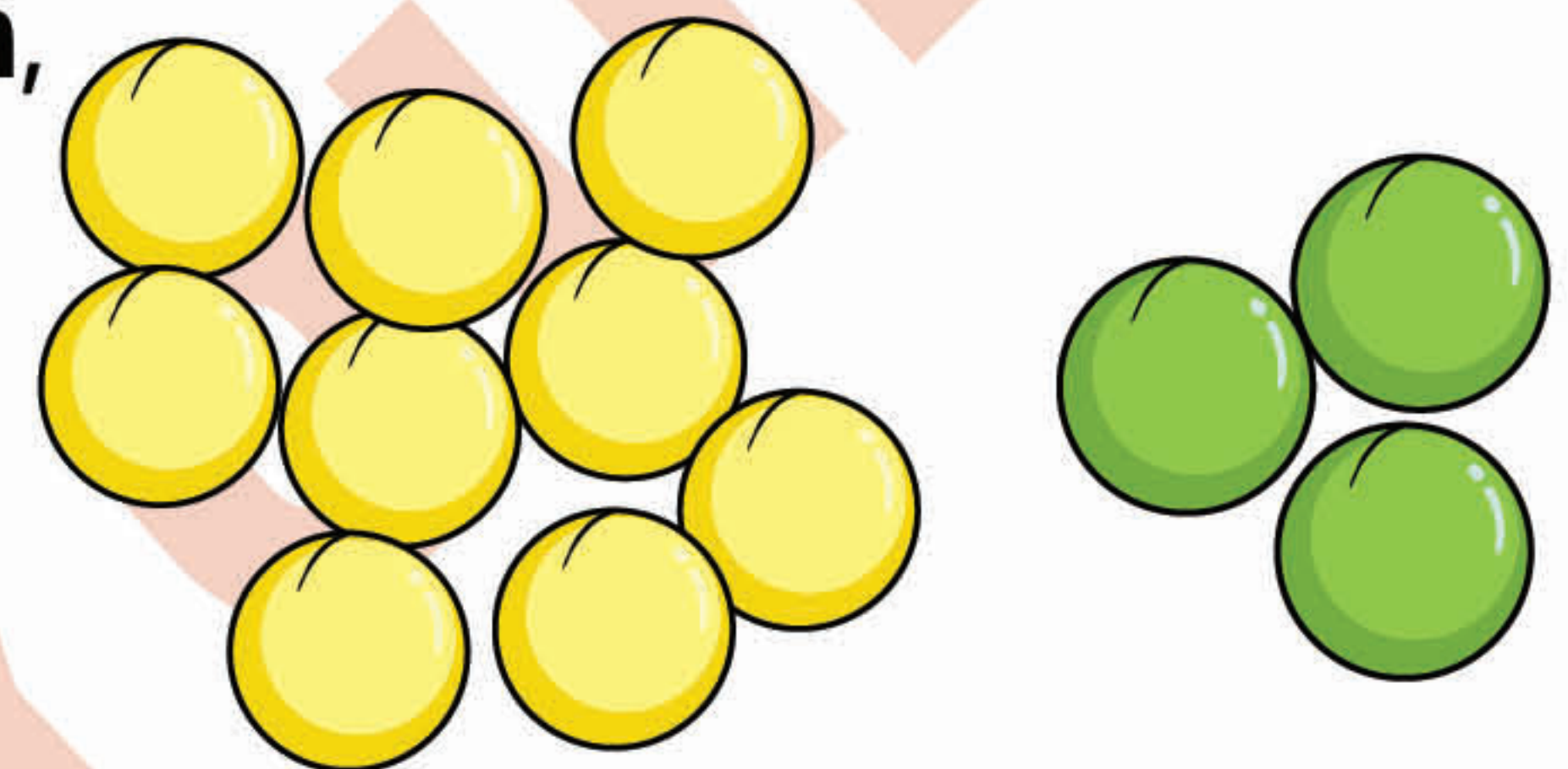
- 4 Mendel let the first generation plants do **self-pollination**, then he planted the resulting seeds.

He observed that:

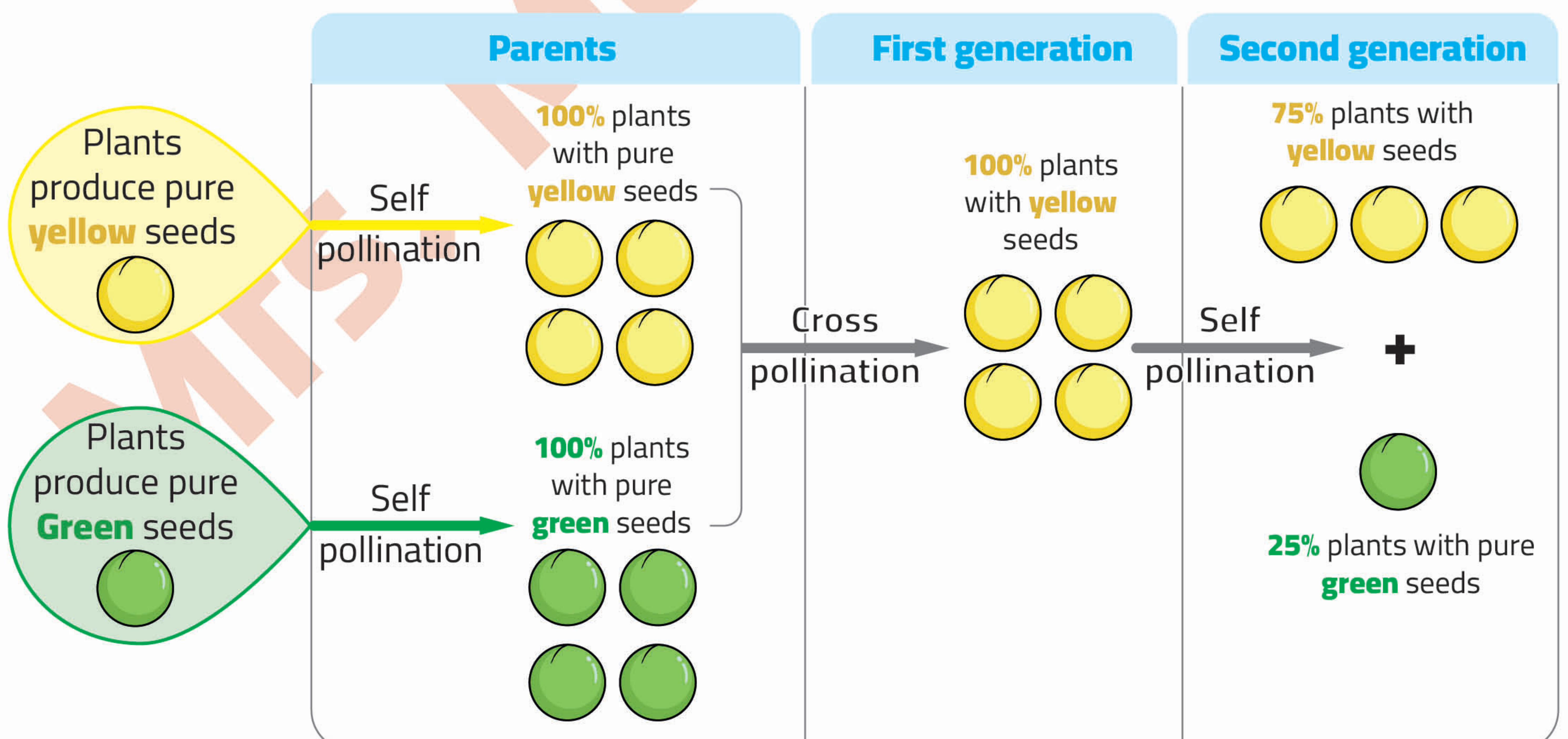
- ★ The produced plants which he named them the **second generation**:

1. Three quarters are of **yellow** seeds (75%).
2. Its quarter is of **green** seeds (25%).

- ★ The **green** color trait of seeds which disappears in the first generation, it appears in the second generation.



Second generation
75% **25%**
yellow seeds : **green** seeds
3 : **1**



The principle of dominance

- When Mendel repeated his previous experiment on the rest of other traits of the pea plant, the results were similar to those obtained from his experiments on the seeds color trait.

The principle of complete dominance

It is the appearance of a dominant hereditary trait in the individuals of the first generation when two individuals are crossed, one of them carries a pure trait contrasting the trait carried by the other individual.

Trait	Dominant trait	Recessive trait
1 Flower color	 Red	 White
2 Flower position	 Side	 End
3 Seed color	 Yellow	 Green
4 Seed shape	 Smooth	 Wrinkled
5 Stem height	 Tall	 Short
6 Pod (fruit) color	 Green	 Yellow
7 Pod (fruit) shape	 Swollen	 Sinuous

Mendel's assumptions to explain the results of his experiments

Assumptions

- 1 The hereditary traits are transmitted from the parents to the offspring by means of hereditary factors carried by **gametes**.
- 2 Each hereditary trait is controlled by two hereditary factors, one from the father and the other from the mother.
- 3 The two hereditary factors of each trait **separate** when the **gametes** are formed, where each gamete carries only one of these two factors.
- 4 During fertilization process, the two hereditary factors aggregate again. If the two factors are:
 - **Similar (or homozygous)**, so the produced trait (**Dominant** or **Recessive**) is **pure** and the individual that carries this trait is called **pure individual**.

Dominant factor + **Dominant factor** → **Pure dominant trait**

Recessive factor + **Recessive factor** → **Pure recessive trait**

- **Different (or heterozygous)**, so the produced trait (**Dominant**) is **impure** and the individual that carries this trait is called **Hybrid individual**.

Dominant factor + **Recessive factor** → **Impure dominant trait**

Applications on the seeds color trait of peas

The color trait of seeds of pea plant transmitted from one generation to another by means of hereditary factors carried by **Gametes** (pollen grains & ovules)

The color of the seeds is controlled by two hereditary factors, one determines the yellow color and the other determines the green color.

The two factors of seed colors are separated during formation of gametes, where each gamete (pollen grain & ovum) carries only one of these two factors.

★ When aggregation:

- The **yellow** color factor of seeds (dominant) with the **yellow** color factor of seeds (dominant), the result are plants with **pure yellow** seeds.
- The **green** color factor of seeds (recessive) with the **green** color factor of seeds (recessive), the result is plants with **pure green** seeds.

★ When aggregation:

- The **yellow** color factor of seeds (dominant) with the **green** color factor of seeds (recessive), the result are plants with **impure yellow** seeds as a result of the **yellow** color factor of seeds dominating over the **green** color factor of seeds.

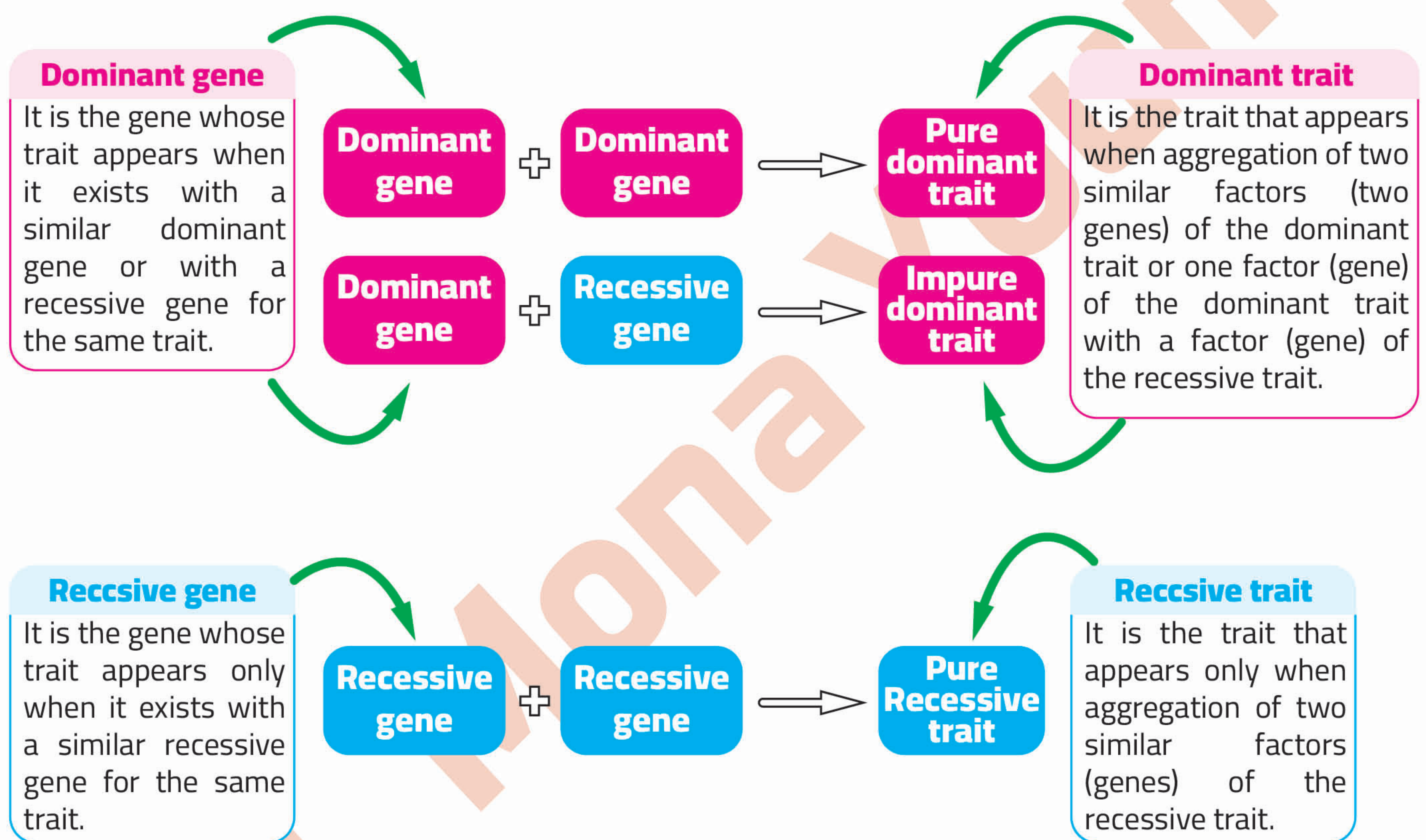
Gametes

The cells by which the hereditary traits are transmitted from plants to offspring.

Law of segregation of factors (Mendel's first law)

When two pure individuals of any pair of hereditary traits are different from each other, only the dominant trait appears in the first generation, while the two traits appear in the second at a ratio of 3 (dominant trait) : 1 (recessive trait).

Note Segregation of factors occurs during the formation of gametes in meiosis.



GIVE REASON

1 Mendel's first law is known as the law of segregation of factors.

To segregate the two factors of hereditary trait from each other during formation of gametes.

2 The disappearance of the green color of the seeds in the first generation, by crossing the two pea plants, one pure green seeds and the other of pure yellow seeds.

Because the green color trait of seeds is a recessive trait that disappears in all individuals of the first generation which carry the dominant trait at a ratio of 100% according to Mendel's first law.

3 When a pure yellow pod pea plant is pollinated with a pure green pod pea plant, they produce plants that are green pods.

Because the green pod trait dominates over the yellow pod trait in the pea plant according to the principle of complete dominance.

4 When you pollinate a pure tall stem pea plant with a short stem pea plant, they produce plants that have tall stems.

Because the tall stem trait dominates over the short stem trait according to the principle of complete dominance.

5 The recessive trait is always pure.

Because it doesn't appear unless two recessive genes aggregate.

	Dominant trait	Recessive trait
Definition	It is the trait that appears when aggregation of two similar factors (two genes) of the dominant trait or one factor (gene) of the dominant trait with a factor (gene) of the recessive trait	It is the trait that appears only when aggregation of two similar factors (two genes) of the recessive trait.
Example	The trait of yellow color seeds of peas.	The trait of green color seeds of peas.
The ratio of its appearance	It appears at a percentage of 100% in the first generation and at a ratio of 75% in the second generation.	It disappears in the first generation and appears at a percentage of 25% in the second generation.
Trait purity	It is pure or hybrid.	It is always pure.

Pure individual

It is the individual that carries a similar pair of genes (factors) either dominant trait or recessive trait, so the dominant trait (pure) or the recessive trait appears on the individual.

Hybrid individual

It is the individual that carries a different pair of genes (factors), one is dominant and the other is recessive, so the dominant trait (impure) appears on the individual.

The Main Principles of Heredity

Part 2

Using symbols to represent the experiments of heredity

Term	Male individual	Mating	Female individual	Parents	Gametes	First generation	Second generation
Symbol	♂	×	♀	P	G	F ₁	F ₂

dominant trait gene is symbolized by **a capital letter**

Tall stem trait gene is symbolized by **T**

Recessive trait gene is symbolized by **a small letter**

Short stem trait gene is symbolized by **t**

Pure dominant individual is symbolized by **two capital letters**

Pure tall stem plant is symbolized by **TT**

Pure recessive individual is symbolized by **two small letters**

Pure short stem plant is symbolized by **tt**

Hybrid dominant individual is symbolized by **a capital letter and a small letter**

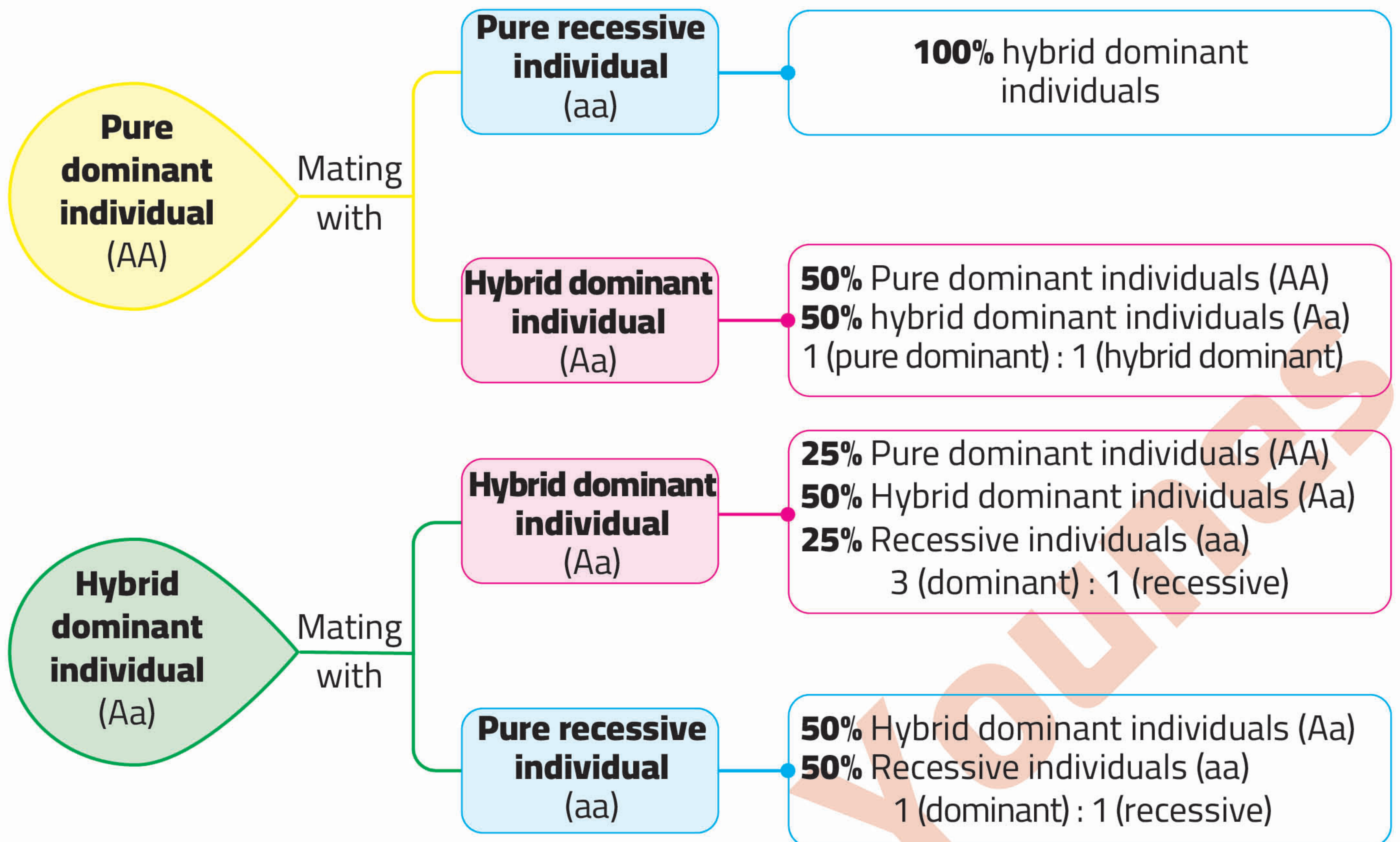
Hybrid tall stem plant is symbolized by **Tt**

Exercise Complete the following table:

Plant	Yellow pod	Pure red flowers	Hybrid smooth seeds	White flowers			Hybrid tall stem	Wrinkled seeds
Genetic structure					tt	GG		

Lesson 1

Science



فكرة 1

If mating takes place between two individuals, and this mating produces individuals are **hybrid** (carry **impure dominant trait**), **this means that** **one of parents** carries the **pure dominant trait** and **the other** carries the contrasting **recessive trait**.

فكرة 2

If mating takes place between two individuals, and this mating produces individuals with a percentage of **50% dominant trait : 50% recessive trait**, **this means that** **one of parents** is **hybrid** (carries **hybrid dominant trait**) and **the other** carries the contrasting **recessive trait**.

فكرة 3

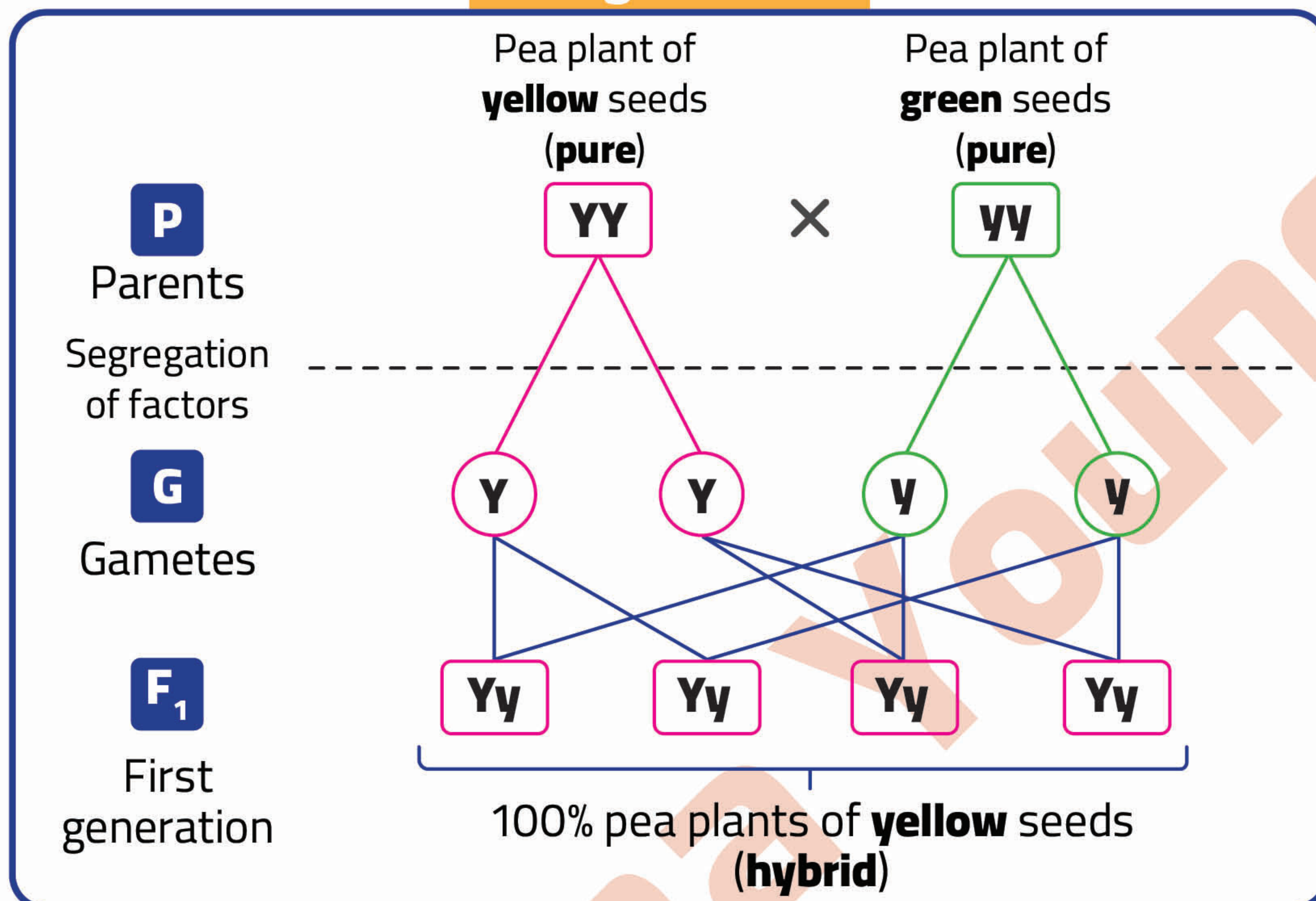
If mating takes place between two individuals, the **dominant trait** appears on them, and this mating produces, some individuals carry the **recessive trait**, **this means that** **both parents** are **hybrid** (carry **impure dominant trait**).

Example 1

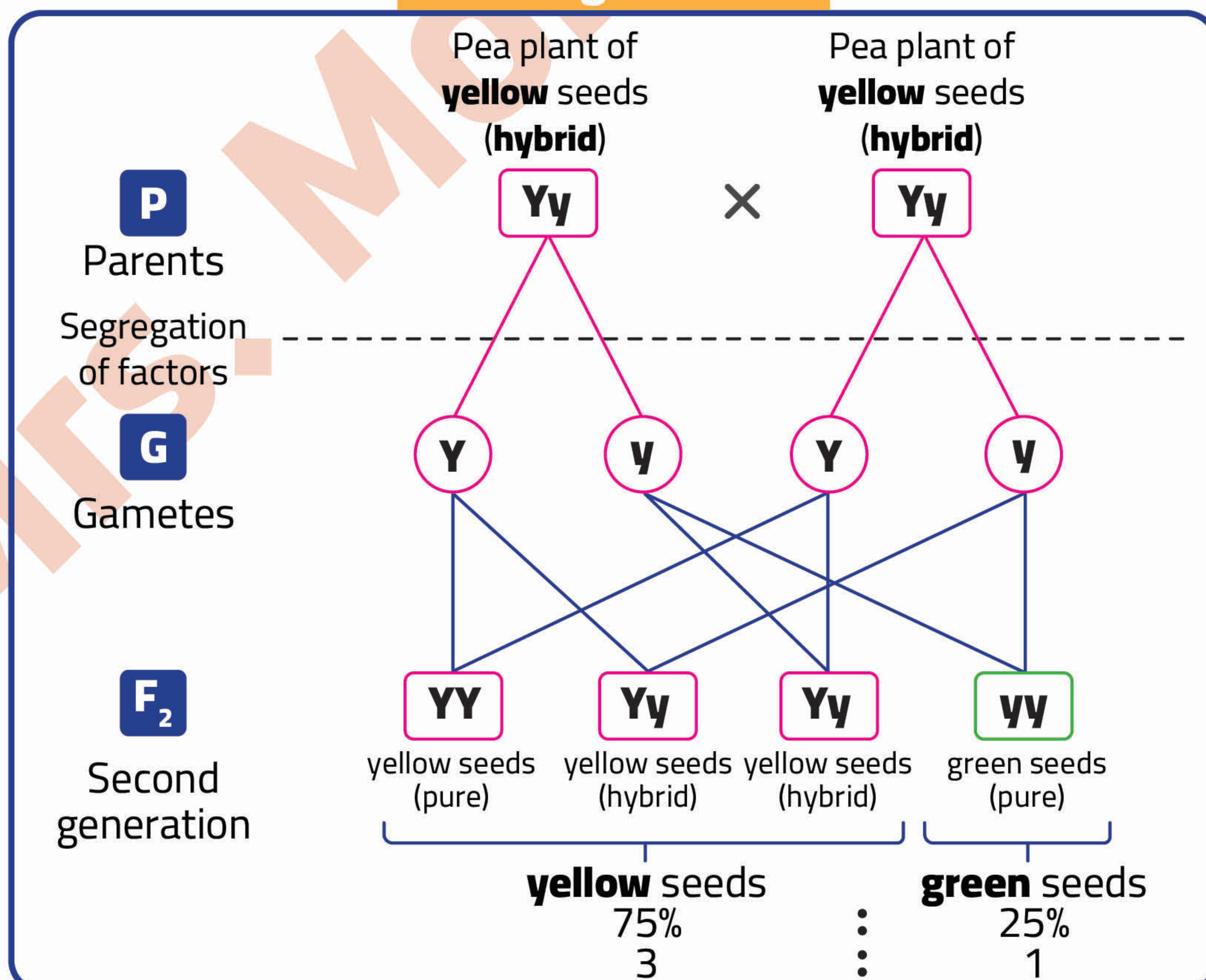
Explain on the basis of genetic principles, the result of mating between two pea plants, one of them has pure yellow seeds and the other of pure green seeds. Mention the ratio between the individuals until the second generation.

Solution

First generation



Second generation



Lesson 1

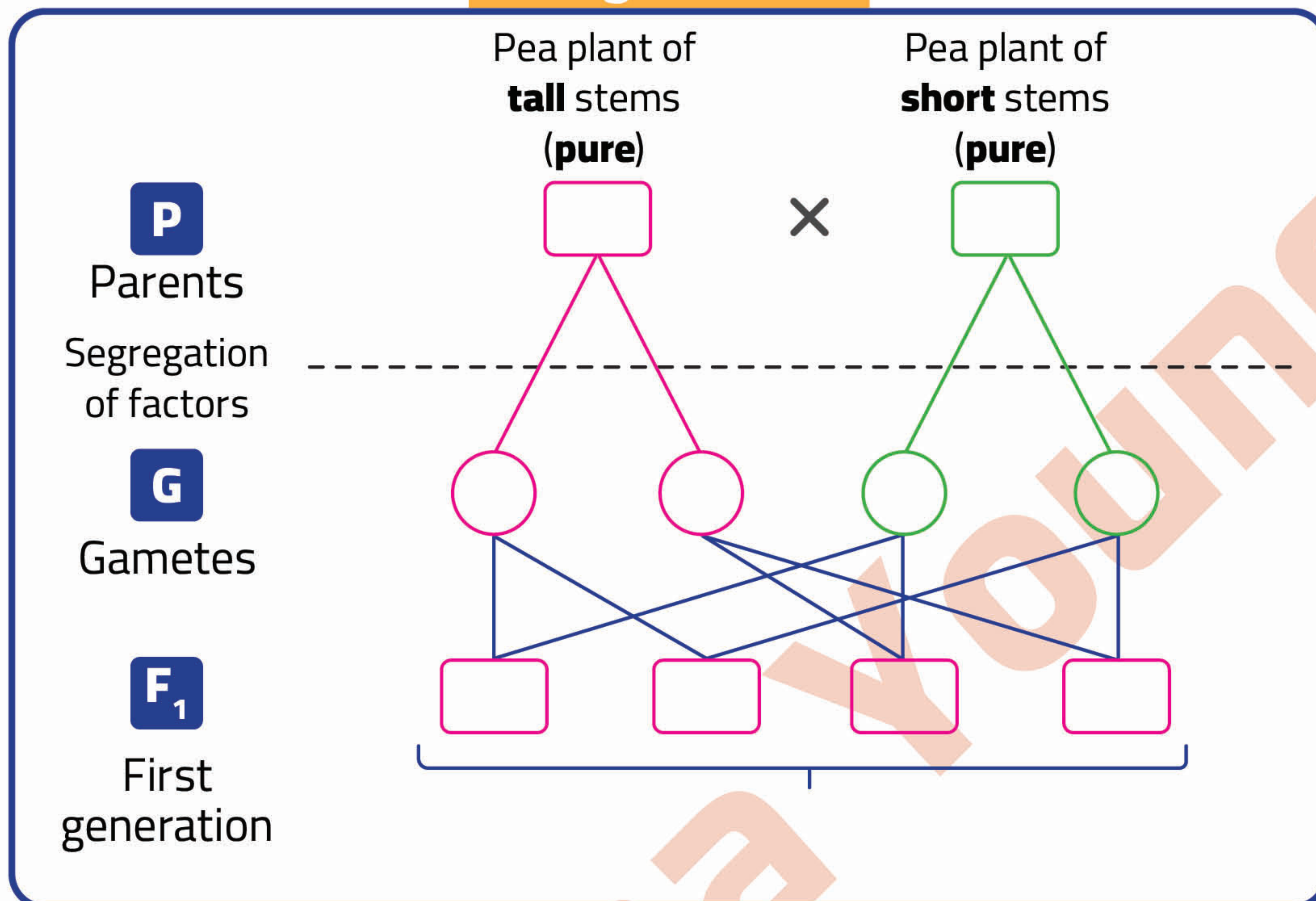
Science

Exercise 1

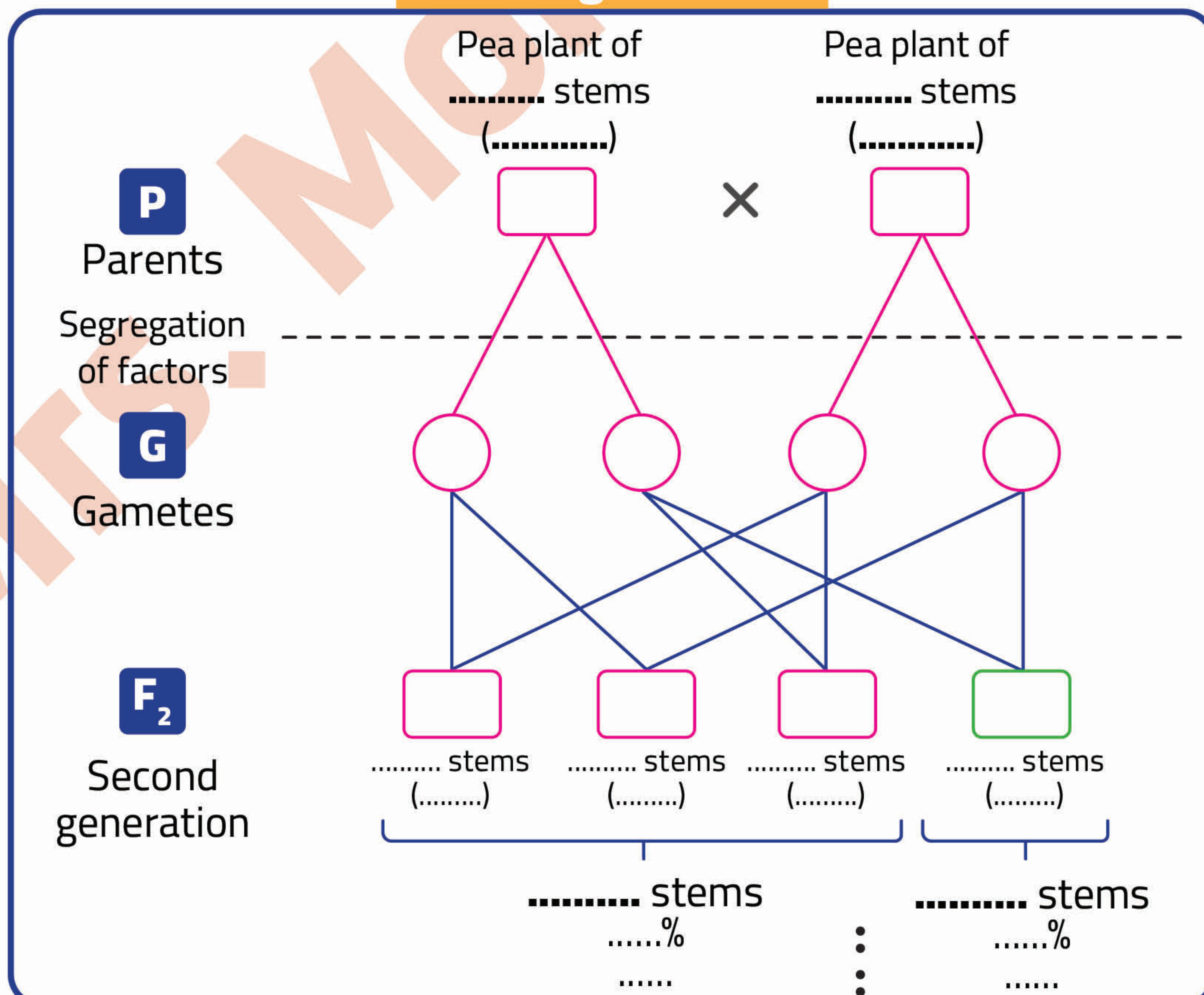
Explain on genetic bases: The genetic composition of the parents, first and second generations produced from crossing a pea plant of pure dominant tall stem with another with recessive short stem. (T dominant - t recessive).

Solution

First generation



Second generation



Exercise 2

Explain on genetic principles: When pollinating flowers of a pea plant with each other, all the produced plants are of red hybrid flowers.

Solution**Exercise 3**

Explain on genetic bases: The properties of the produced generation from self-pollination in a pea plant that has hybrid yellow seeds, knowing that the dominant gene is symbolized by (Y) & the recessive one is symbolized by (y).
Mention the ratio of the produced individuals.

Solution

Exercise 4

If self-pollination takes place for pea plant of green fruits, some of the produced plants are green fruits and others are yellow fruits. **Use symbols to express this mating and mention the ratio of the produced individuals.**

Solution

Blank area for the solution to Exercise 4.

Exercise 5

Explain on genetic bases: The traits of the individuals resulted from mating hybrid black male mouse with hybrid black female mouse. If the black color gene (B) dominates over the brown color gene.

Solution

Blank area for the solution to Exercise 5.

Exercise 6

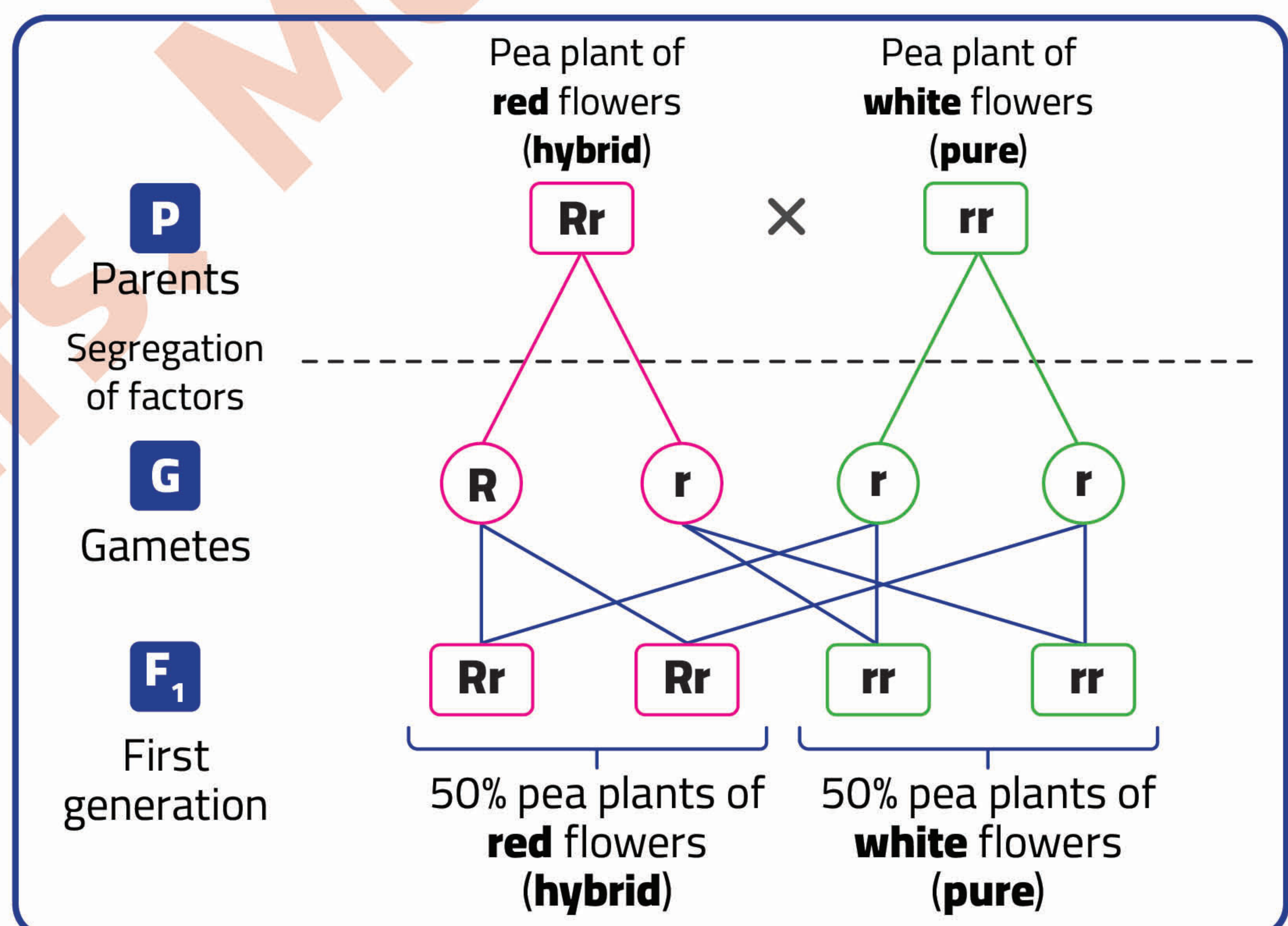
If you know that the free ear lobe (Y) is a dominant trait, while attached ear lobe (y) is a recessive trait, **explain on genetic bases** the traits of the offspring resulted from the crossing between man and woman both of them is hybrid for these traits (Yy).

Solution**Example 2**

If crossing takes place between two pea plants, one of them with red flowers and the other with white flowers, this crossing produces individuals with a percentage of 50% red flowers : 50% white flowers.

Explain on the bases of genetic principles:

The genetic structure of the parents and the produced individuals. Knowing that the symbol of the dominant gene is (R) and that of the recessive gene is (r).

Solution

Exercise 7

When a pea plant that has a tall stem is crossed with a pea plant that has a short stem, this crossing produced individuals at a percentage of 50% tall: 50% short. **What is the genetic structure** of parents and producing individuals (use "T" for tall and "t" for short)?

Solution

Blank area for the solution to Exercise 7.

Exercise 8

If crossing takes place between two pea plants, one with pure red flowers and the other with white flowers, **explain on genetic bases** the result of the crossing between one the first generation with a plant of white flowers.

Solution

Blank area for the solution to Exercise 8.

If crossing takes place between two pea plants, one of them with yellow seeds and the other with green seeds, this crossing produced 50% yellow seeds and 50% green seeds.

Exercise 9**Explain genetic principles:**

- The genetic structure of first generation.
- The gametes forming first generation.
- The genetic structure of the produced generation.

Solution**Exercise 10**

A pollination between a tomato plant of red fruits happened with another green, the resulting ratio were 50% red fruits plants and 50% green fruits plants, so **explain on hereditary bases** showing the ratio of the resulting individuals and characteristics. [Note that: symbol (R) refers to the gene of red and symbol (r) refers to the gene of green].

Solution

Second Study the inheritance of two pairs of contrasting traits

Mendel conducted a mixed pollination between two pea plants

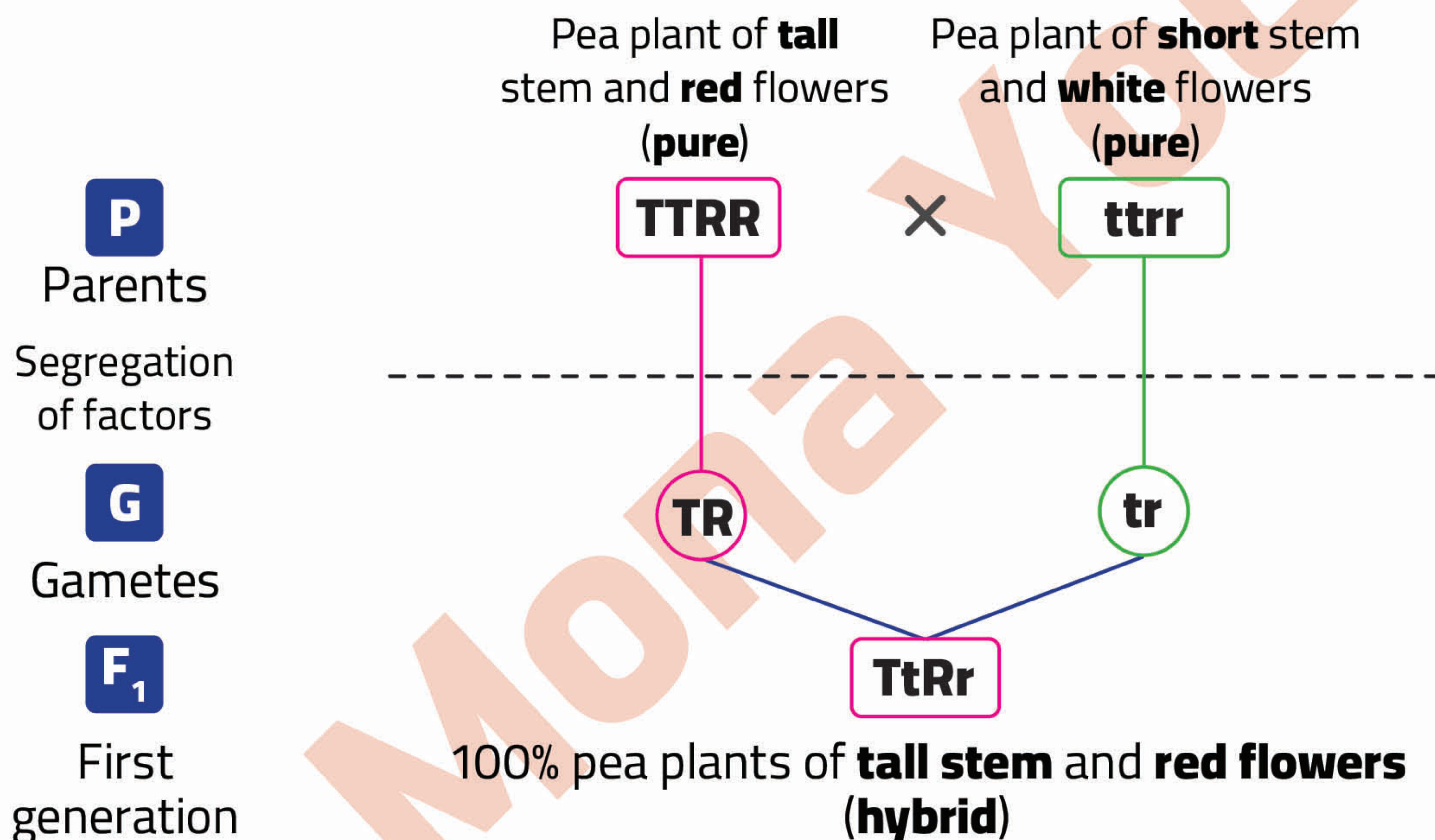
- One of pure tall stem and red flowers (the two traits are pure dominant).
 - The second with pure short stem and white flowers (the two traits are recessive).
- Then he planted the produced seeds.



Mendel observed that:

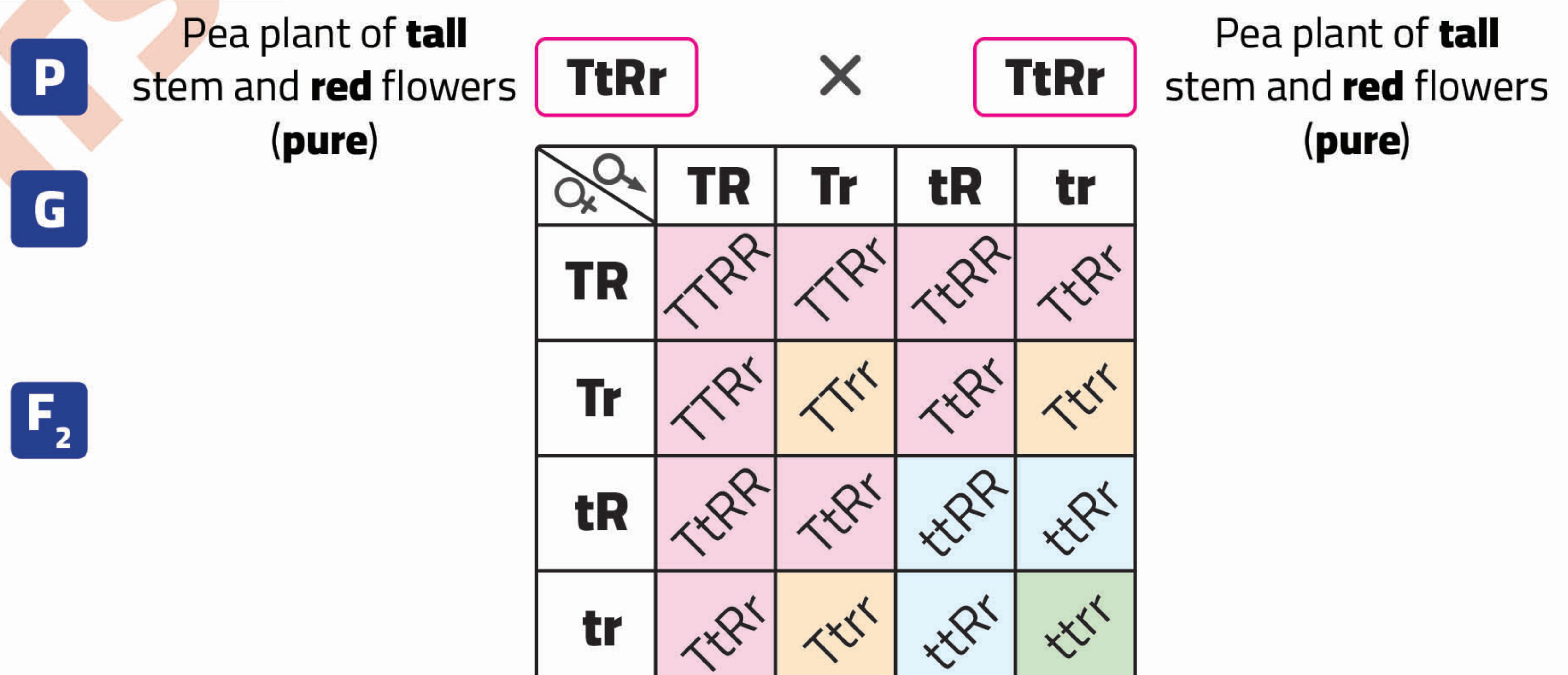
All the first generation plants had tall stem and red flowers (carry the dominant trait at a ratio of 100%).

1



Mendel left the first generation plants to self-pollinate, then he planted the produced seeds.

Mendel observed that:



Upon classification the traits of the produced individuals:

- according to the two pairs of contrasting traits, the result is as follows:

Traits of individuals of second generation	Tall stem & red flowers	Tall stem & white flowers	Short stem & red flowers	Short stem & white flowers
Ratio	9	3	3	1

- according to each pair of the contrasting traits, the result is as follows:

Stem height trait		Flower color trait	
Plants of tall stem	Plants of short stem	Plants of red flowers	Plants of white flowers
12	4	12	4
3	1	3	1

Law of independent assortment of hereditary factors (Mendel's second law)

When two pure different individuals bearing a pair or more of alternative (contrasting) traits are crossed, the trait of each pair is inherited independently of the others and appears in the second generation at a ratio of 3 (dominant trait) : 1 (recessive trait).

Lesson 1

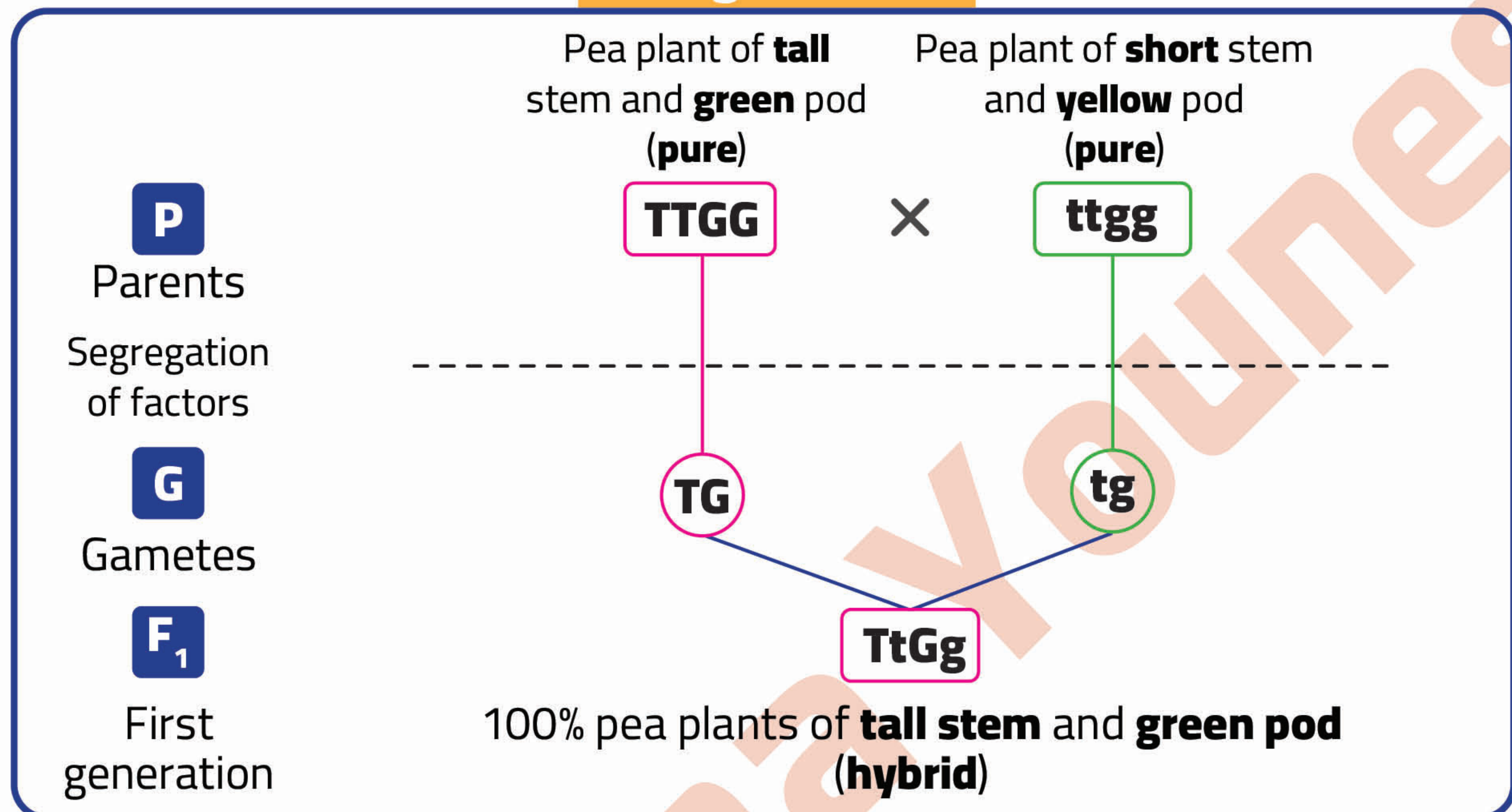
Science

Example 1

Using symbols to express the results produced from crossing between a pea plant with tall stem and green pod color (TTGG) and another one with short stem and yellow pod color (ttgg). [Illustrating: Parents - Gametes - First generation - Second generation in generation in each crossing].

Solution

First generation



Second generation

P

G

F₂

Pea plant of **tall** stem and **green** flowers (pure)

TtGg

×

TtGg

Pea plant of **tall** stem and **green** flowers (pure)

♀ \ ♂	TG	Tg	tG	tg
TG	TTGG	TTGg	TtGG	TtGg
Tg	TTGg	TTgg	TtGg	Ttgg
tG	TtGG	TtGg	ttGG	ttGg
tg	TtGg	Ttgg	ttGg	ttgg

Traits of individuals of second generation

Tall stem & green pod

Tall stem & yellow pod

Short stem & green pod

Short stem & green pod

Ratio

9

:

3

:

3

:

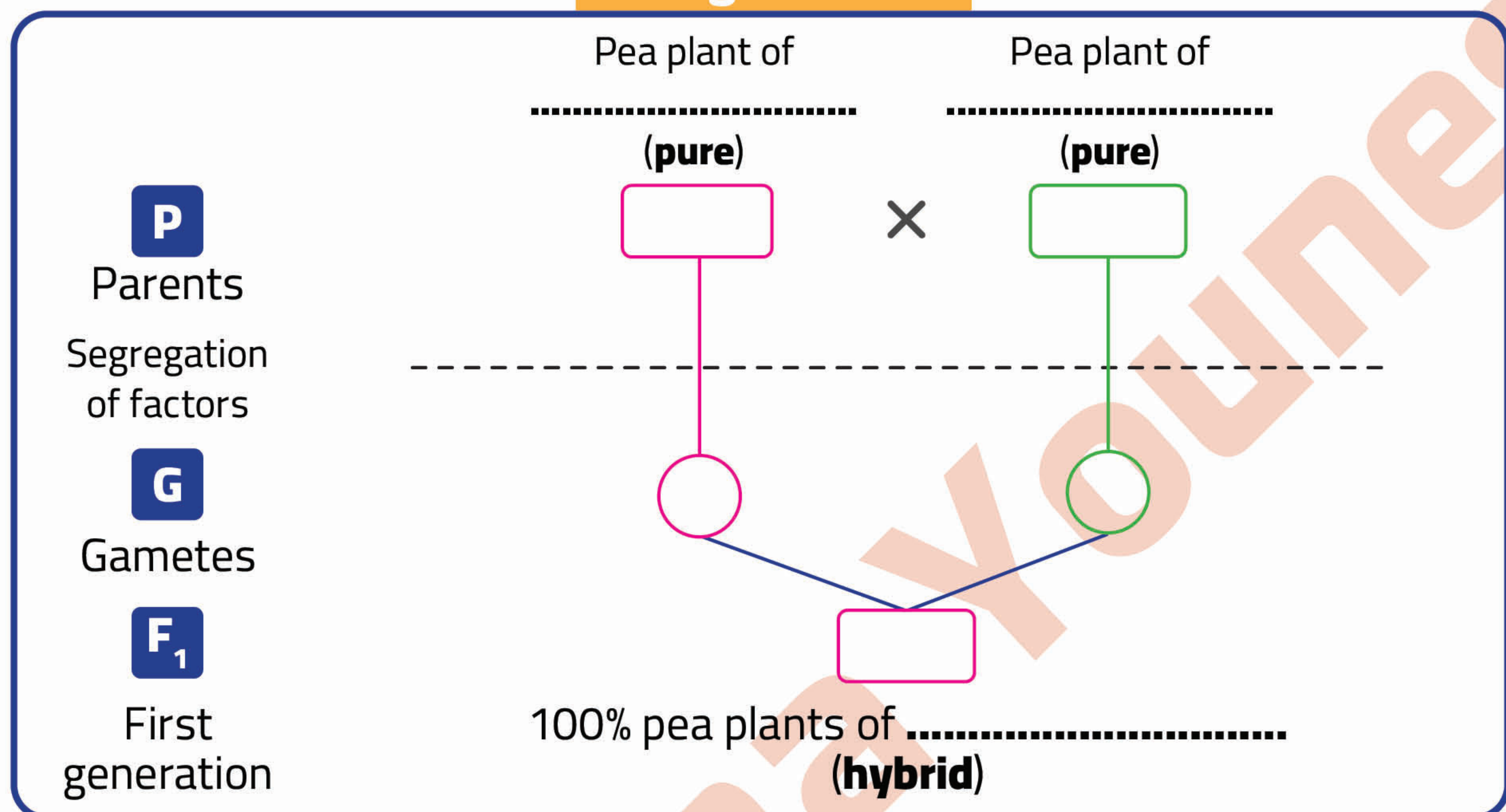
1

Exercise 1

If crossing takes place between two pea plants, one of them with smooth yellow seeds (SSYY) and the other with wrinkled green seeds (ssyy). **Explain on genetic principles** the genetic structure for the first and the second generations.

Solution

First generation



Second generation

Pea plant of (.....) × Pea plant of (.....)

P

G

F₂

♀ \ ♂				

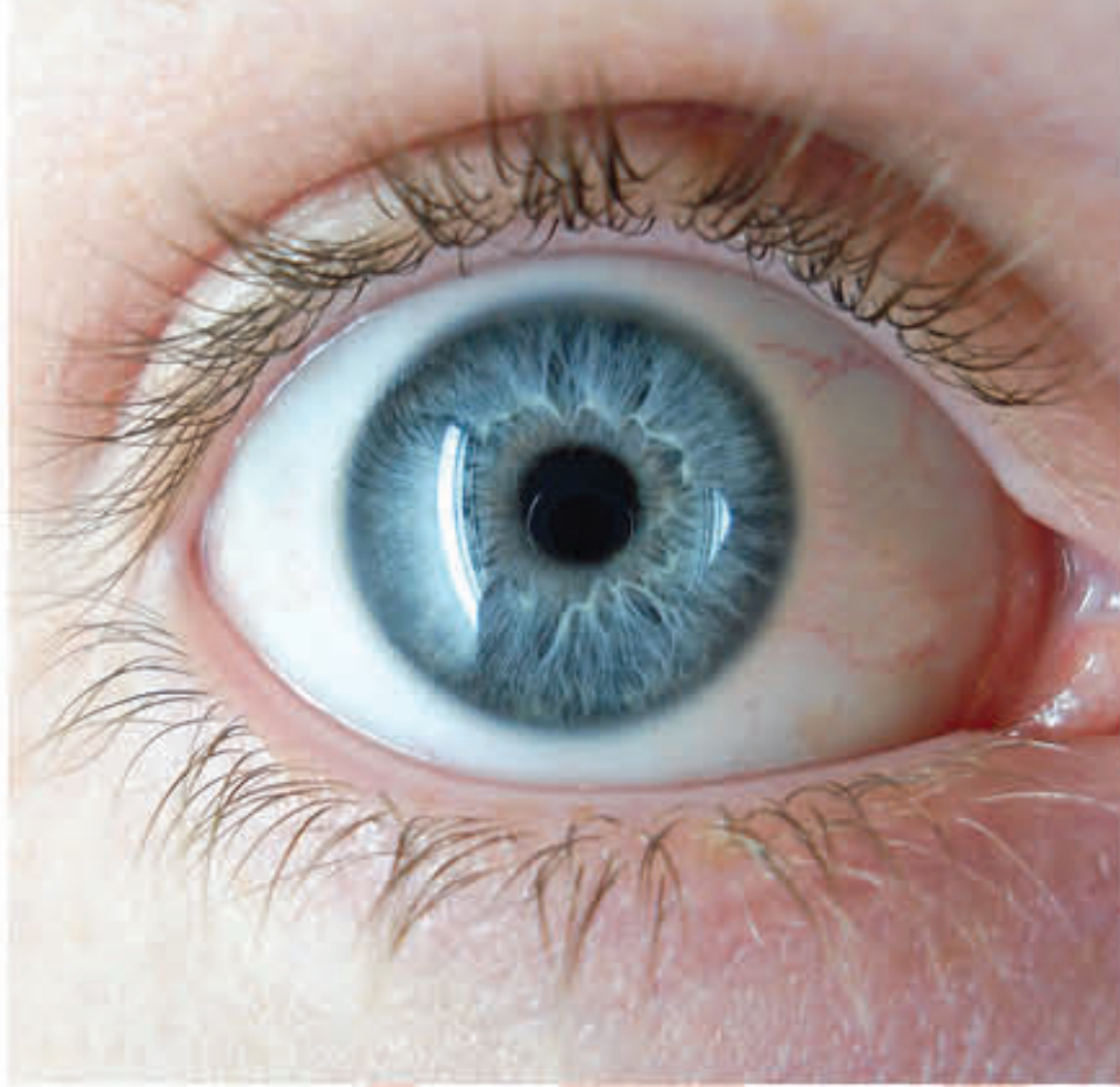
Traits of individuals of second generation

Ratio

The dominant and recessive traits in humans

- ★ Scientists found that many human hereditary traits follow the **Mendelian heredity** where the trait is controlled by **one pair of genes**.
 1. The individuals that inherit at least one dominant gene from one of their parents, will have the **dominant trait**.
 2. Those who receive a recessive gene from both parents, will have the **recessive trait**.
- ★ The following table shows some of the **human traits** that follow the **principle of complete dominance**:

Trait	Dominant trait	Recessive trait
1 Tongue	 The ability to roll the tongue	 The inability to roll the tongue
2 Ear lobe	 Free ear lobe	 Attached ear lobe
3 Nature of hair	 Curly hair	 (Straight) Smooth hair
4 Color of hair	 Black hair	 Light color hair

5 Size of eyes	 Wide eyes	 Narrow eyes
6 Color of eyes	 Brown eyes	 Colored eyes (Blue, green, grey)
7 Cheek dimples	 Dimples	 No dimples
8 Facial freckles	 No freckles	 Freckles

GIVE REASON

1 The curly hair trait dominates over the smooth hair trait.

Because the gene of curly hair dominates over the gene of smooth hair when they aggregate together.

2 If one individual inherited from one of his parents the gene that carries the curly hair trait, so this individual will be with curly hair.

Because the gene of curly hair is a dominant gene, its trait appears if it exists with another similar dominant gene (curly hair) or with a recessive gene (straight hair).

3 The ability of rolling the tongue is a dominant trait in the human being.

Because the gene of the ability to roll the tongue dominates over the gene of the non-ability to roll the tongue if they are both present together in an individual.

4 The free ear lobe is dominant over the attached ear lobe.

Because the gene of the free ear lobe dominates over the gene of the attached ear lobe if they are both present together in an individual.

5 The wide eyes trait dominates over the narrow eyes trait in human.

Because the gene of wide eyes dominates over the gene of narrow eyes if they are both present in an individual.

6 It is possible for two parents to have a free ear lobe and produce an offspring having an attached ear lobe.

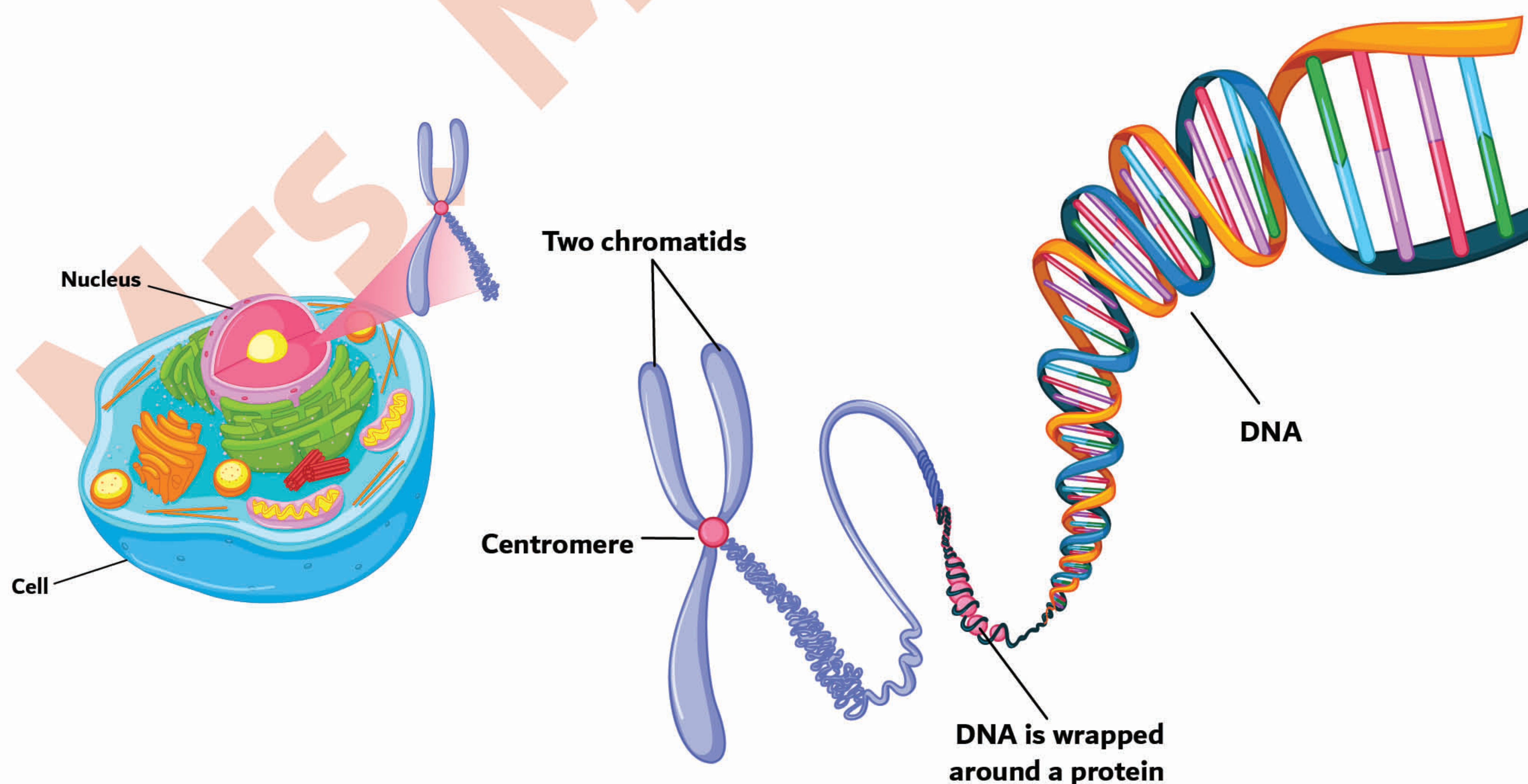
Because both parents are hybrid, so the dominant trait (free ear lobe) appears on them, but when the two factors of recessive trait (attached ear lobe) aggregate from each of them, this trait appears in offspring.

The chemical structure of nucleic acid (DNA)

★ We have studied in the first term that:

- The cell nucleus contains chromosomes.
- The chromosomes chemically consists of a nucleic acid (DNA) combined with a protein.
- DNA (nucleic acid) carries the hereditary (genetic) traits of the living organism.

★ Scientists have found that the nucleic acid (DNA) consists of small parts called "Genes".



Genes

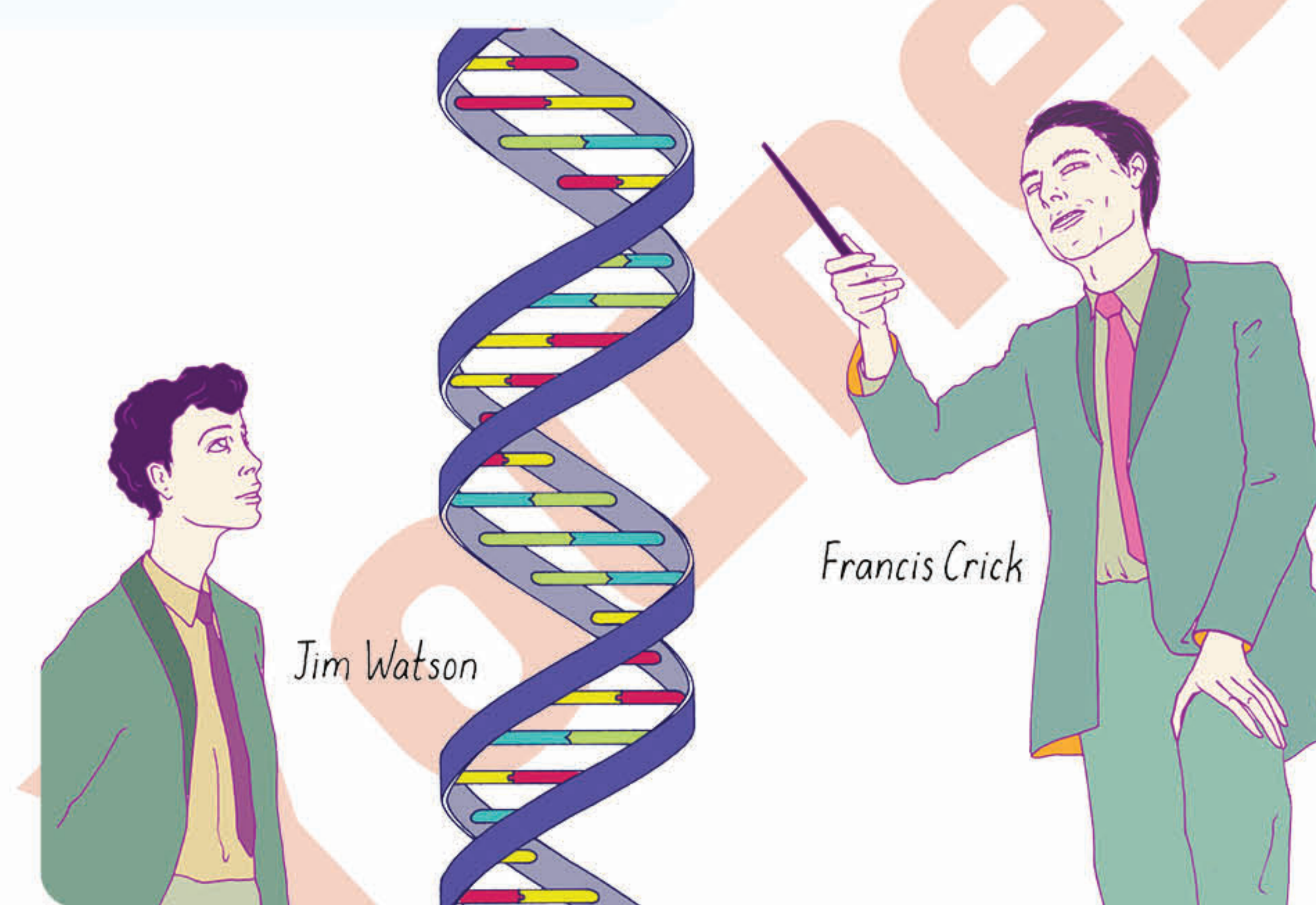
They are parts of DNA present on the chromosomes and they are responsible for appearing the individual's hereditary traits.

- ★ Genes consist of smaller structural units called "**nucleotides**".



Model of Watson and Crick for composition of DNA molecule

- ★ The scientists **Watson** and **Crick** were able to make a model of the DNA molecule.
- ★ DNA molecule is composed of two strands coiled around each other forming a **double helix shape**.



How do genes perform their functions?

- ★ The scientists **Beadle** and **Tatum** discovered the means of how the genes control the appearance of genetic traits.
- ★ The two scientists received a Nobel prize in the year 1958.

Explain ■ **Mechanism of action of the gene.**
 ■ **How do the genes control the appearance of genetic (hereditary) traits?**

- 1 Every gene gives a special **enzyme**.
- 2 This enzyme is responsible for the occurrence of a **chemical reaction**.
- 3 Each chemical reaction resulting a **protein** showing a **specific hereditary trait**.



**GIVE
REASON**

- 1 **DNA is the source of the genetic formation of the living organism.**

Because DNA consists of genes which are responsible for the occurrence of a chemical reaction resulting a protein showing a specific hereditary trait.

2 The enzymes play an important role in the appearance of the hereditary traits.

Because every gene gives a special enzyme which is responsible for the occurrence of a chemical reaction resulting in a protein that shows a specific hereditary trait.

Genetic engineering (Bio-technology)

- Genetic engineering is one of the branches of modern genetics and one of its most important applications is in the field of medical agriculture is the production of **genetically modified rice** to fight diseases caused by malnutrition.



Genetically modified rice

- Around 500 000 people every year are affected by losing their sight in developing countries).** GIVE REASON
Due to malnutrition caused by the deficiency in vitamin (A). It is one of the most important elements of nutrition, whose deficiency leads to malnutrition.
- Deficiency in vitamin (A) is widespread in those who depend on eating rice.** GIVE REASON
Because rice does not contain pro-vitamin (A) which is known as carotene which is converted into vitamin (A) inside the body.
- This health problem has been solved by the production of **genetically modified rice** containing **carotene**.

Scientific basis

- Modifying the genetic composition of the rice crop by inserting the genes that result in the creation of the pro-vitamin (A) compound inside the tissue that store starch in the rice grain.

Human genome project

The human genome

It is a genetic map that shows the complete set of genes that are present on the human chromosomes.



Aims of the project

- **This project started in October 1990 to obtain a detailed very precise map for the sequence of the nitrogenous bases to be able to:**
 1. Determination all the human inheriting factors (genes) and identification the various hereditary functions to the human.
 2. Identification the genes responsible for the various diseases like cancer, diabetes, vascular diseases, mental diseases.
 3. Determination the various mutations on the functions of the genes.
 4. Understanding the human biology and identifying the single differences in the genome between one person and another.

Resultants of the project

- This project showed the similarity of humans in more than 99% from the sequency of nucleotides of DNA.
- Therefore, the single differences in humans **such as**: eye color, skin color, height and other traits form a very small percentage of this sequency.
- **Despite the small percentage of these differences**, they affect to a great extent the acceptance of the individual to:
 1. The harmful environmental effects like bacteria, viruses, poisons, chemicals.
 2. Medicines and various treatments.

Hormone

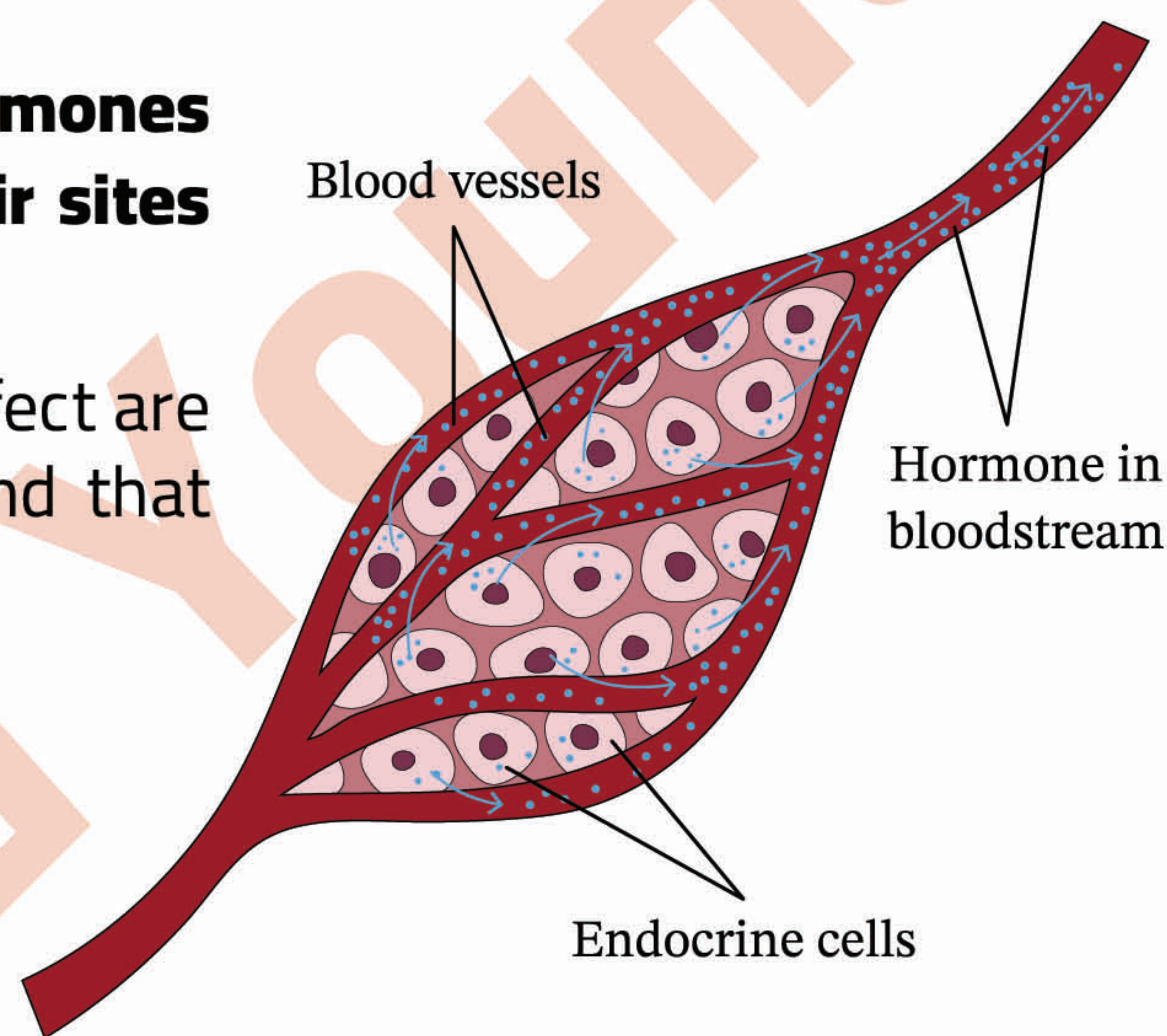
It is a chemical substance (or a chemical message) that controls and organizes most the vital activities and functions in the bodies of living organisms.

Endocrine glands (ductless glands)

They are ductless glands that secrete their hormones directly in blood without passing through ducts.

- ★ **Blood is considered the only way for the hormones (secreted by endocrine glands) to reach their sites of action (target cells).** **GIVE REASON**

Because the target cells that the hormones affect are almost located away from the endocrine gland that secretes the hormone.



Hormone

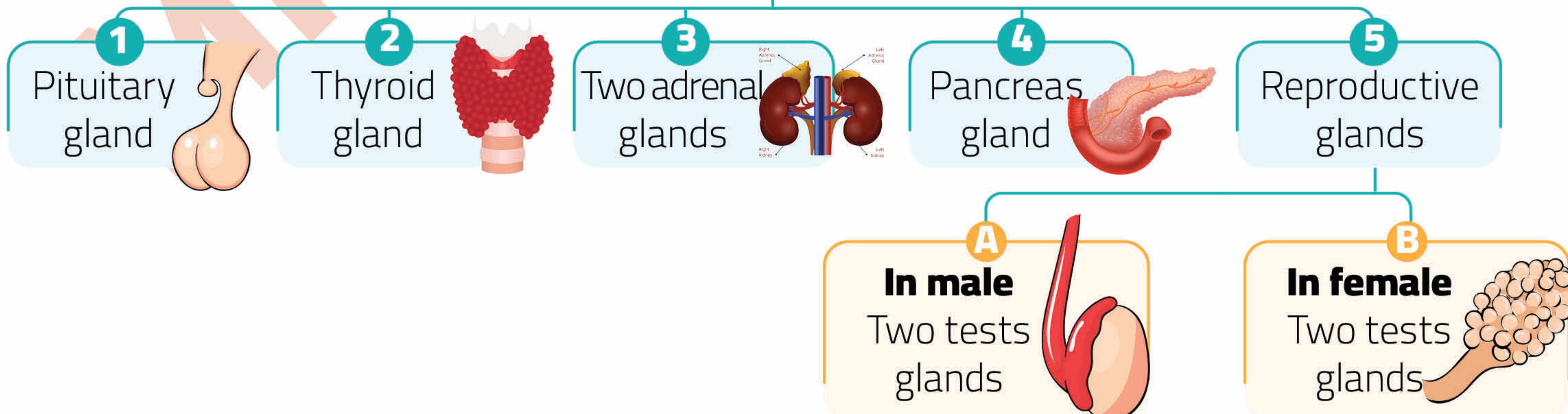
They are the cells that the hormones affect and they are almost located away from the endocrine glands that secretes the hormone.

GIVE REASON

The endocrine glands (ductless) are called by this name.

Because they secrete their hormones directly in blood without passing through ducts.

The most important endocrine glands in the human body



- ★ Endocrine glands more than 50 hormones in the human body in limited quantities.

Hormone disorder

It is the increase or decrease in the secretion of one of the hormones as a result of a disorder in the action of the endocrine gland responsible for it abnormally.

1 Pituitary gland

Description

- It is a small gland in the size of a pea seed.
- It consists of two lobes.

Location

It is located below the brain.

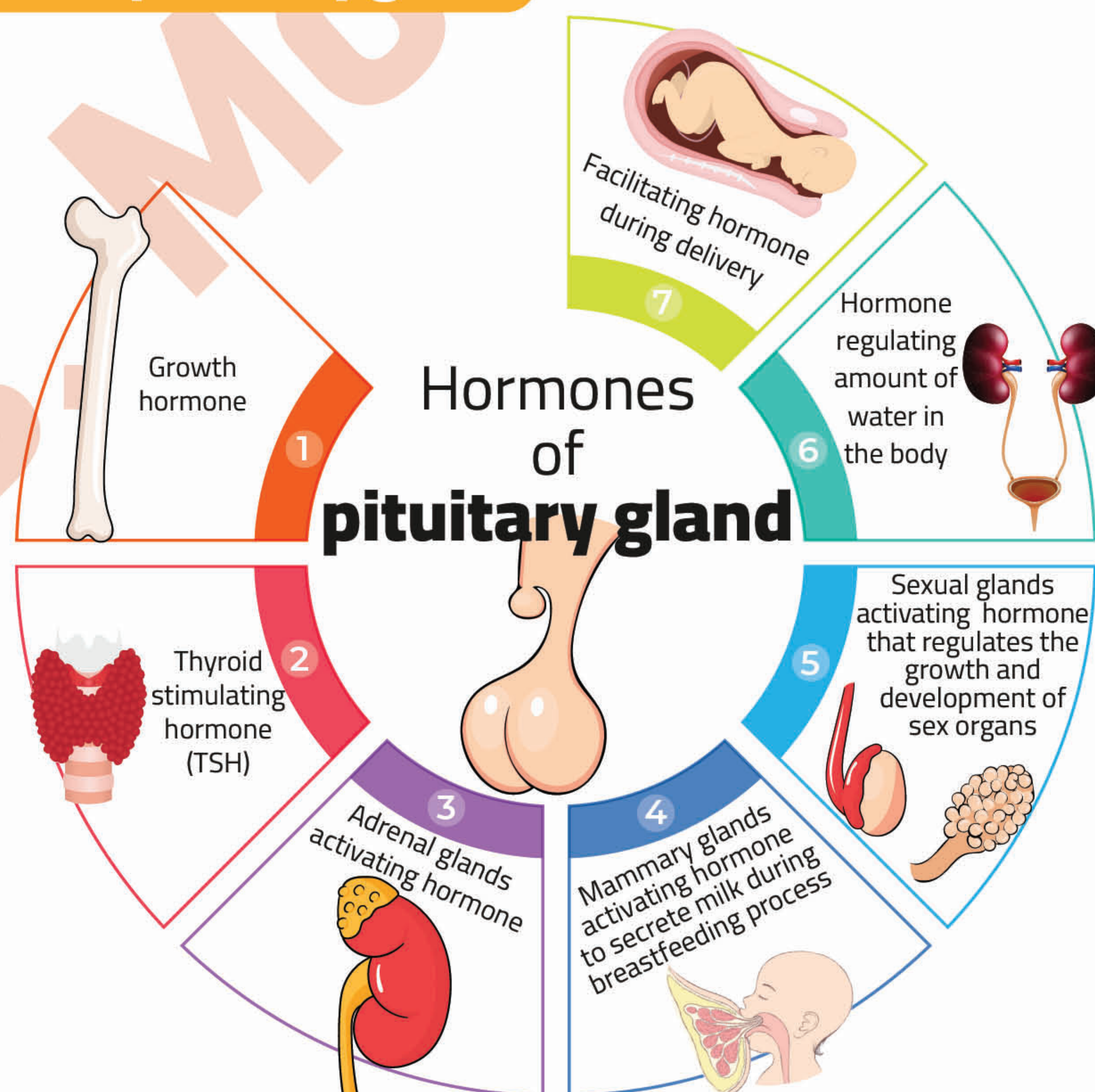
Importance

It secretes hormones that regulate the activities of most of other endocrine glands. So, it is called the "master gland" or the "main gland".

Secretion

Each lobe of the two lobes of the pituitary gland secretes a group of different hormones.

Some hormones of the pituitary gland



Growth hormone

- ★ **Importance:** It controls the speed of growth rate of body muscles, bones and other organs.
- ★ **So,** It determines the height that the person will reach when he becomes fully grown.



Some diseases resulted from growth hormone disorder

Dwarfism

Gigantism

Reason

Decrease in the secretion of the growth hormone at the childhood.

Increase in the secretion of the growth hormone at the childhood.

Feature of disorder

The body stops growing, so the person becomes a dwarf.

A continuous growth in the limbs' bones, so the person becomes a giant.



GIVE REASON

1 Pituitary gland is called the master gland.

Because it secretes hormones that regulate the activities of most of other endocrine glands.

2 The pituitary gland plays an important role in delivery and breast feeding processes.

Because it secretes the facilitating hormone during delivery and the mammary glands activating hormone to activate the mammary glands to secrete milk during breast feeding processes.

- 3 ▪ **The height of some persons may exceed 2 meters.**
 ▪ **The limbs' bones of some people grow continuously, so they become giants.**
 Due to the increase in the secretion of the growth hormone at childhood.

- 4 ▪ **The height of some persons may reach less than half a meter.**
 ▪ **The stopping of the body growth, so the person becomes a dwarf.**
 Due to the increase in the secretion of the growth hormone at childhood.

2 Thyroid gland

Description

It consists of two lobes, linked together by a small part.

Location

It is located in the front surface of the neck on both sides of the trachea.

Secretion

It secretes two hormones, which are:

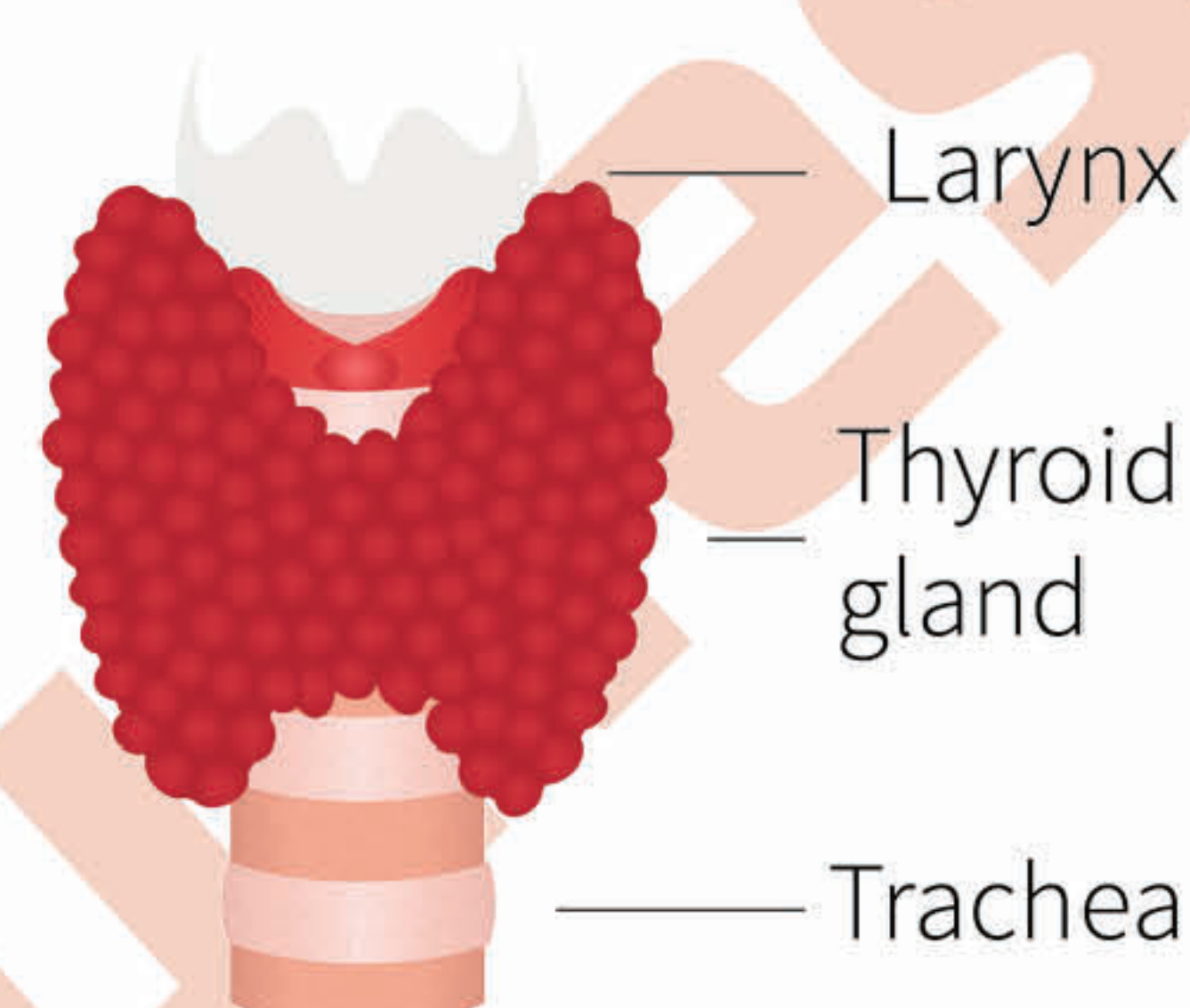
Thyroxin hormone

It plays a main role in **food assimilation processes** in the body, where it liberates the energy necessary for the human body from food.

Its importance

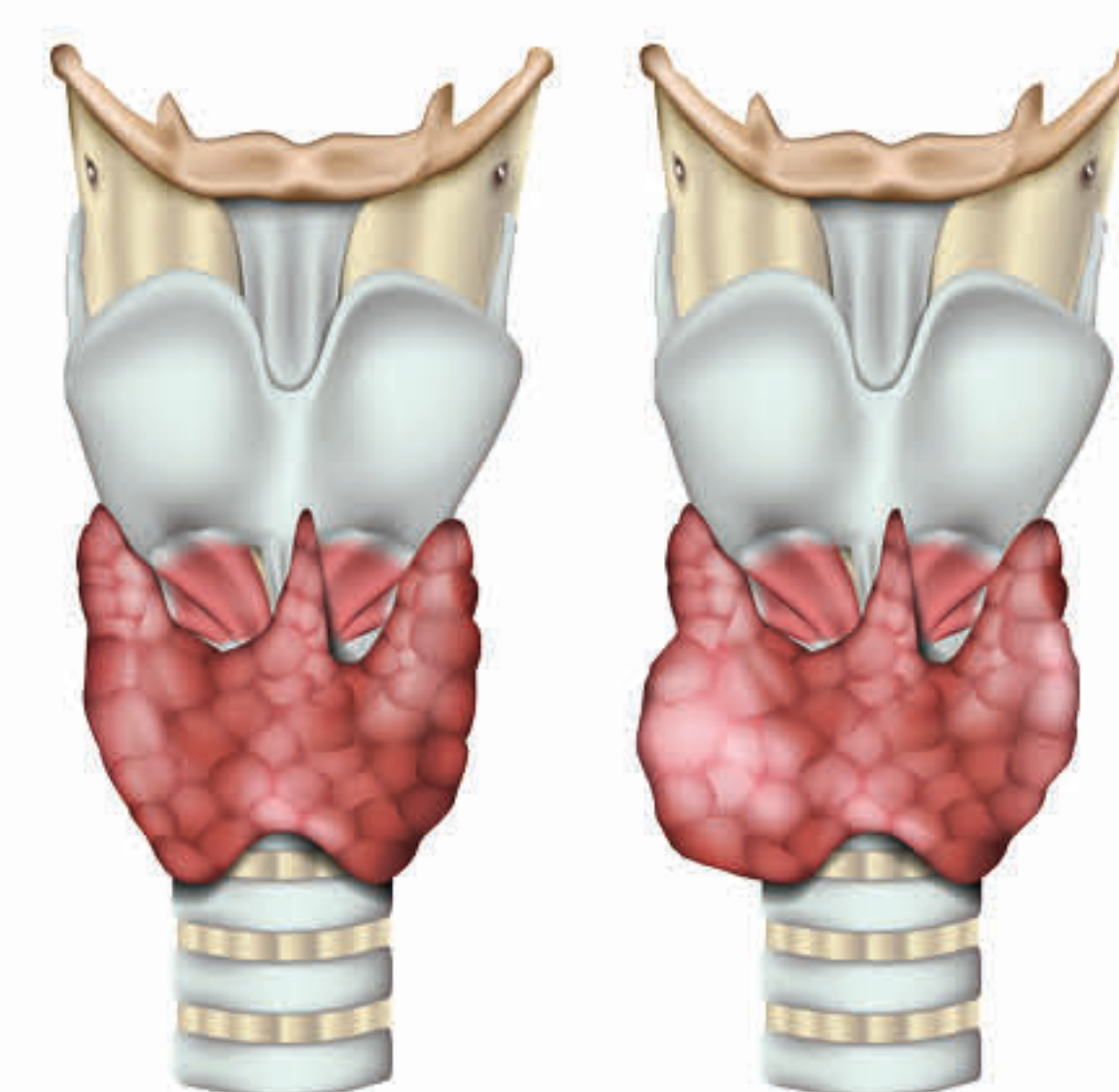
Calcitonin hormone

It controls the **level of calcium** in blood.



Some diseases resulted from thyroxin hormone disorder

- ★ **Features of disorder:** On occurrence of a disorder in the secretion of the thyroxin hormone from the thyroid gland, this will lead to the infection of the goiter disease which has 2 shapes as follows:



Simple goiter

Decrease in the secretion of the thyroxin hormone due to the lack of iodine from food as it enters in the hormone's structure.

Reason

Increase in the secretion of the thyroxin hormone in large amounts.

Symptoms of disease

Enlargement of thyroid gland and the neck.

Enlargement of thyroid gland accompanied by loss of weight, tension and exophthalmoses.

GIVE REASON

- 1 ▪ **Iodine salt is preferred than normal salt.**
▪ **The food must contain iodine.**
Because iodine salt is rich in iodine element that enters in thyroxin hormone's structure.
- 2 **Some persons have enlarged thyroid gland.**
Due to the decrease or increase in the secretion of thyroxin hormone.
- 3 **Man suffers from simple goiter disease when his food lacks iodine.**
Due to the decrease in the secretion of thyroxin hormone as a result of the lack of iodine from food as it enters in the hormone's structure.
- 4 **Thyroid gland plays an important role in controlling the level of calcium in blood.**
Because it secretes calcitonin hormone which controls the level of calcium in blood.

WHAT HAPPENS WHEN

- 1 **When the glands that secrete hormones have ducts.**
The blood will not be the only way for the hormones to reach their sites of action.
- 2 **When the deficiency of growth hormone secretion at adulthood.**
The body stops growing, so the person becomes a dwarf.
- 3 **If the secretion of growth hormone is increased at childhood.**
A continuous growth in the limb's bones, so the person becomes a giant.
- 4 **To the human when thyroxin hormone secretion increases.**
The human will suffer from exophthalmic goiter.
- 5 **When man takes a litter amount of iodine in his food.**
This leads to decreasing in secretion of thyroxin hormone and this leads to that the human suffers from simple goiter.

3 Two adrenal glands

Location

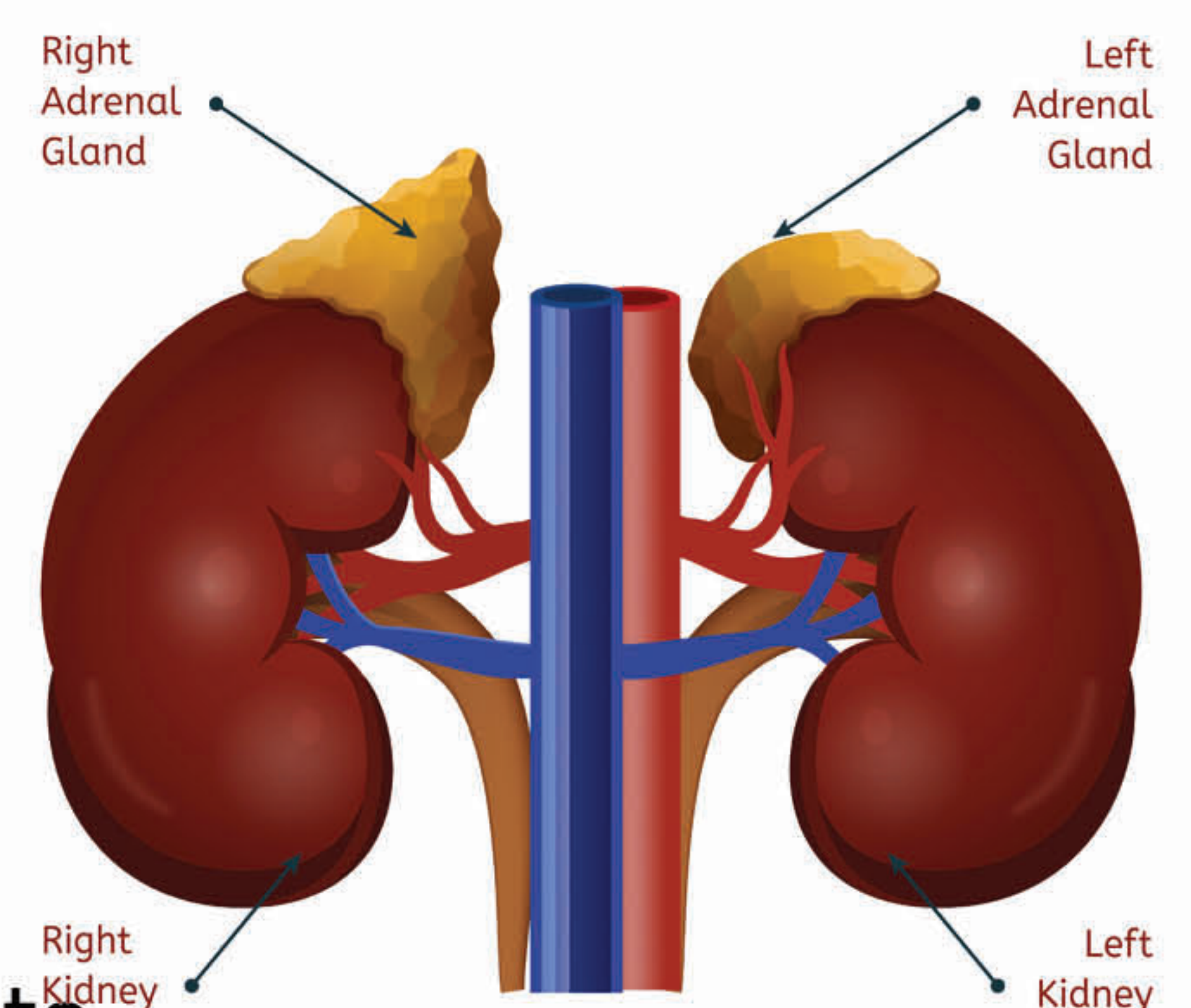
They are located adhering the top of kidney.

Location

They secrete adrenalin hormone.

Its importance

It stimulates body's organs to respond to emergencies like: fear, anger and emotion.



GIVE REASON

The two adrenal glands have an important role when man is exposed to emergency.

Because they secrete the adrenalin hormone that stimulates the human body's organs to respond to emergencies.

WHAT HAPPENS WHEN

When man is exposed to emergency or fear or horror.

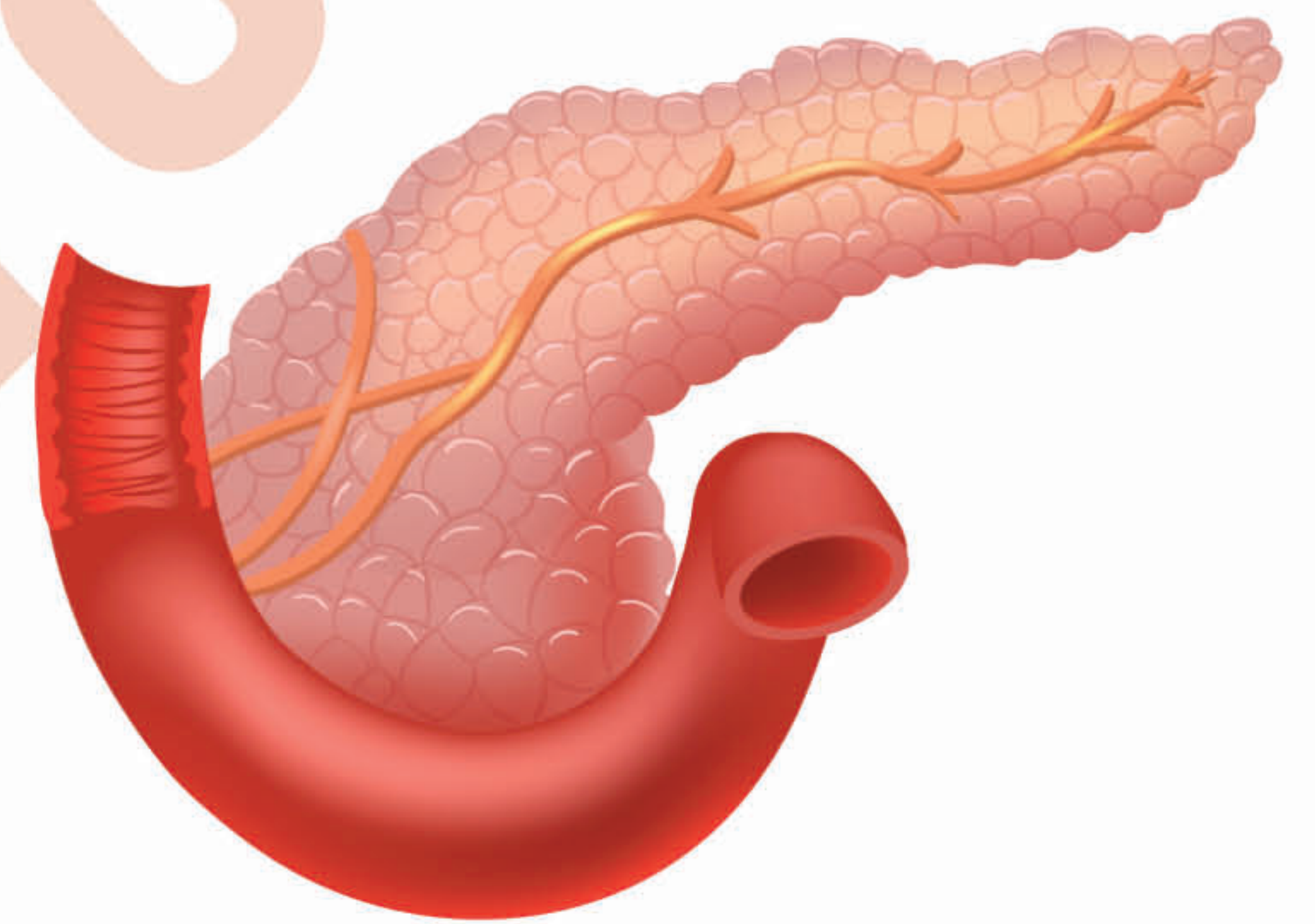
Pituitary gland responds by secretion of adrenal glands activating hormone, so these adrenal glands secrete adrenaline hormone which stimulates body's organs to respond to emergencies.

4 Pancreas gland**Location**

It is located between the stomach and the small intestine.

Secretion

It secretes two hormones, which are:

**Insulin hormone****Its importance**

It reduces the level of glucose sugar in blood.

By stimulating

- Body cells to use glucose as a source of energy.
- Liver cells to store glucose sugar that increases in the body in the form of glycogen.

Glucagon hormone

It raises the level of glucose sugar in blood.

Liver cells to convert the stored glycogen into glucose sugar that release into the blood stream to be available to body cells.

Insulin hormone

converts

Glucose sugar in blood

into

Glycogen in liver cell**Glucagon hormone**

converts

Glycogen in liver cells

into

Glucose sugar in blood**Note**

The function of glucagon hormone contradicts the function of insulin hormone.

GIVE REASON

1 Pancreas is a mixed gland.

Because the pancreas acts as a ductless gland which secretes the insulin and glucagon hormones that regulate the glucose sugar level in blood and it also secretes digestive juices that help in digestion process through a duct.

2 Pancreas is a double function gland.

Because the pancreas secretes the insulin hormone and the glucagon hormone and the function of each hormone contradicts the function of the other hormone.

WHAT HAPPENS WHEN

1 The level of glucose sugar in blood increase than the normal level.

The pancreas gland will respond by secreting insulin hormone.

2 The level of glucose sugar in blood decreases than the normal level.

The pancreas gland will respond by secreting glucagon hormone.

3 To blood sugar level when pancreas does not secrete glucagon hormone.

The level of glucose sugar in blood decreases.

Features of disorder in the secretion of insulin hormone

Diabetes

It is a disease caused by the decrease in the secretion of the insulin hormone which leads to increasing of the level of glucose sugar in blood and its existence with the urine.



Reason

Decrease in the secretion of the insulin hormone which leads to the cells being unable to use glucose.

Symptoms

Feeling very thirsty and multiple urination times.

GIVE REASON

Diabetes disease is treated with insulin hormone.

Because it reduces the percentage of glucose sugar in blood.

WHAT HAPPENS WHEN

If the pancreas decreases its secretion of the insulin hormone.

The level of glucose sugar in blood increases (diabetes disease).

5 Reproductive glands

A Two testes glands

- ★ They secrete testosterone hormone.

Its importance It is responsible for the appearance of the male secondary sex characters.



B Two ovaries glands

- ★ They secrete two hormones:

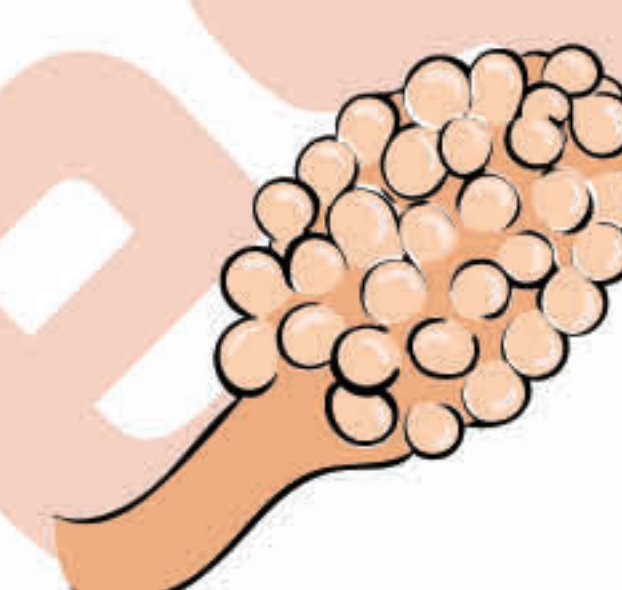
Estrogen hormone

It is responsible for the appearance of the female secondary sex characters.

Its importance

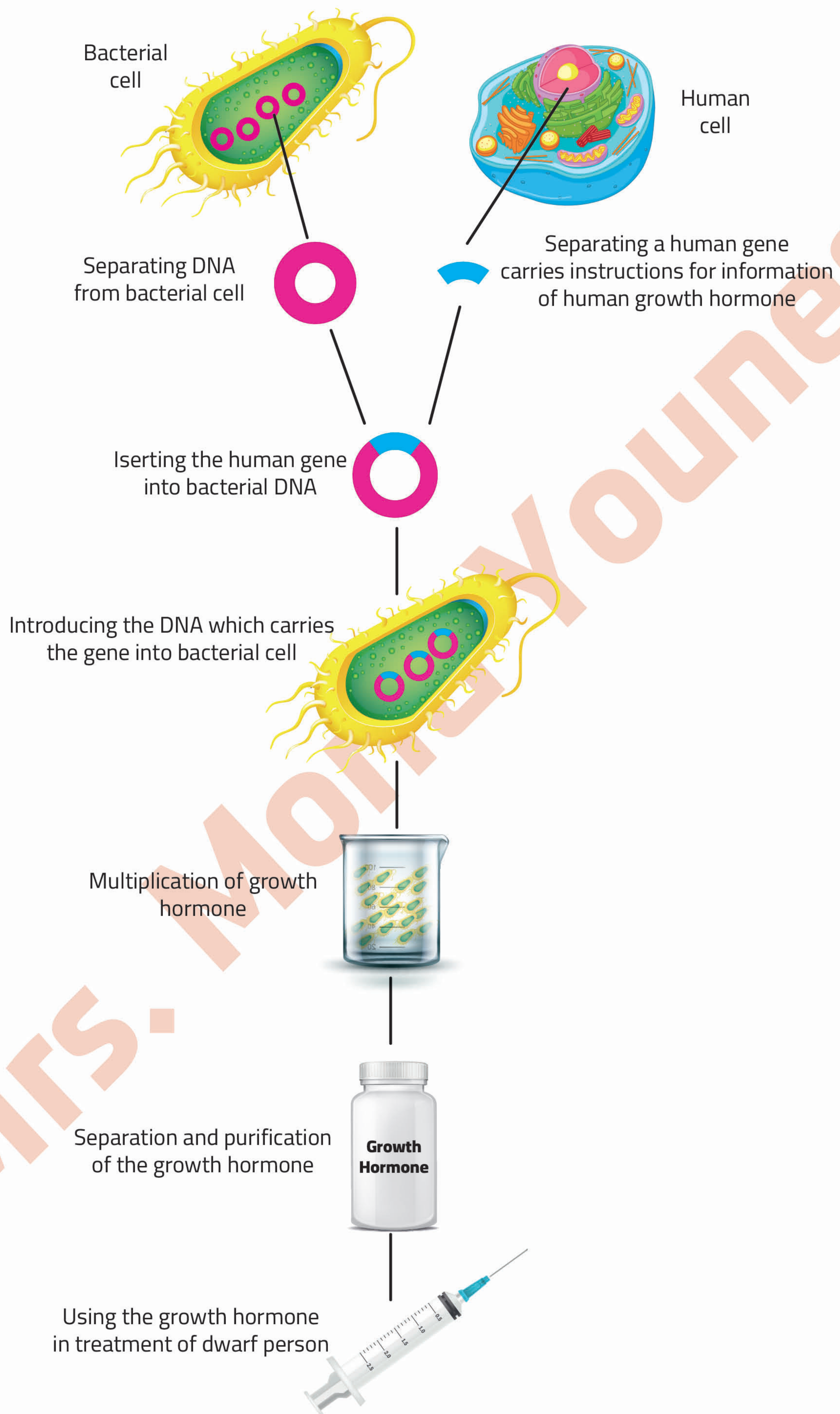
Progesterone hormone

It promotes the growth of endometrium (The lining of uterus).



Synthesis of growth hormone by genetic engineering:

- Pituitary gland in the body of dwarf persons secretes extremely small amount of growth hormones.
- In the past, scientists treated these people by injecting human growth hormone extracted from the newly dead corpses in the children's bodies with not enough growth hormone.
- But, the amounts of growth hormone obtained by this method were not enough in addition to the possibility of containing some microbes which may cause infection by various diseases.
- In 1979, by the genetic engineering technology, scientists manufactured sufficient amount of human growth hormone by inserting a human gene that carries instructions for formation of human growth hormone into DNA nucleic acid of the bacterial cells.
- In this way, they were able to produce and collect large amounts of the human growth hormone by great numbers of bacteria (in which this gene was inserted) then, this hormone was refined and tested.
- In 1985, the research conducted on this hormone proved its validity for the human use to treat the children of limited growth.



	Hormones	Functions
Pituitary gland	Growth hormone	Regulates the growth of the body as a whole, where it controls the speed growth rate of: - The muscles. - The bones. - Other organs.
	Thyroid stimulating hormone	Stimulates thyroid gland to secrete thyroxin and calcitonin hormones.
	The activating hormones of sexual glands	- Regulates the growth and the development of sex organs. - Activates the sexual glands to secrete their hormones prior to adulthood stage.
	Adrenal glands activating hormone	Activates the two adrenal glands to secrete adrenalin hormone.
	Mammary glands activating hormone	Activates the mammary glands to secrete milk during breast feeding process.
Thyroid gland	Thyroxin hormone	Liberates the energy necessary for the body from food.
	Calcitonin hormone	Controls the calcium level in the blood.
Adrenal gland	Adrenaline hormone	Stimulates the body organs to respond to emergencies.
Pancreas gland	Insulin hormone	Stimulates the storage of glucose sugar in liver. (When the glucose level increases in blood)
	Glucagon hormone	Stimulates the release of glucose sugar in liver. (When the glucose level increases in blood)
The two ovaries	Estrogen hormone	Enables the female secondary sex characters to appear.
	Progesterone hormone	Promotes the growth of endometrium.
The two testes	Testosterone hormone	Enables the male secondary sex characters to appear.

WHAT HAPPENS WHEN

1 When testosterone hormone is not secreted at adulthood stage in males.

The male secondary sex characters will not appear.

2 When estrogen hormone is not secreted at adulthood stage in females.

The female secondary sex characters will not appear.